



**Testimony of
Dr. Steven Beering, Chairman
National Science Board**

**Before the Research and Science Education Subcommittee
House Committee on Science and Technology
February 26, 2008**

Chairman Baird, Ranking Member Ehlers and Members of the Committee, I appreciate the opportunity to address you today. My name is Steven Beering, and I am the Chairman of the National Science Board. I am honored to represent the twenty-four members of the National Science Board before you today.

On behalf of the entire National Science Board¹, I would like to thank the Members of this Subcommittee for your long-term commitment in support of the National Science

¹ *The National Science Board was established by Congress in the National Science Foundation Act of 1950 to oversee the activities of the National Science Foundation and to serve as an independent advisory body to the President and Congress on national policy issues related to science and engineering research and education. The twenty-four members of the board are national leaders in diverse areas of science and engineering research and education from around the country, who are nominated by the President and confirmed by the Senate to serve six-year terms. The NSF Director also serves as an ex-officio member of the Board.*

Foundation and its investments in a broad portfolio of research and education in science, technology, engineering, and mathematics. We also applaud your strong bipartisan support for legislation over the past year that will bolster U.S. leadership in science and technology, including the passage of H.R. 2272, the America COMPETES Act, last August. The science and engineering communities were also encouraged to see that this committee recommended increases in funding for basic scientific research in the Commerce, Justice, Science, and Related Agencies Appropriations Act last year. With the President and Congress in agreement about the importance of science and engineering research and education for U.S. innovation and competitiveness, the stakeholders in science and engineering research and education looked forward to advances in discovery and innovation that would be enabled by the promised budget increases.

The National Science Board and the broader science and engineering community were surprised and disappointed by the actual appropriations in the fiscal year 2008 omnibus bill, which erased most of the anticipated increases in support for research. Now, instead of expanding research activities as planned, we are confronted with the possibility of layoffs for outstanding researchers in our National Laboratories and the frustrating reality that our Federal research funding programs will be forced to turn away many innovative ideas that would have received awards if funding had been in keeping with the objective of doubling over 10 years for NSF, National Institute of Science and Technology in Department of Commerce, and the Office of Science at the Department of Energy.

The 2008 omnibus bill has significantly impacted the National Science Foundation's mission to support basic research in the United States. The 1.3 percent increase in the research and related activities budget is below the rate of inflation, and thus represents a decline in support for these activities. If the FY 2008 omnibus were in line with the budget doubling that was supported by the President's American Competitiveness Initiative and the America COMPETES Act, NSF estimates that they would have been able to award 1000 more grants and 230 more graduate research fellowships this year. NSF has also shelved several program solicitations that were planned for 2008, including

a new program in Computer and Information Science and Engineering for the development of a competitive workforce and the Office of Polar Programs' program on Climate Change and Changing Seasonality in the Arctic program.

In such an uncertain funding climate, we are concerned with the signal this sends to our potential partners in international science projects but also the signal sent to international and American students who may be deterred from pursuing science and engineering careers in this country. As many other countries invest heavily in science and engineering research, graduate a record number of scientists and engineers, and increase incentives to attract outstanding international students and scholars, it is a dangerous time for the U.S. to neglect our science and engineering enterprise.

Although the United States is still the world leader in science, technology, and engineering, the findings of the National Science Board and of many other eminent bodies representing a wide range of perspectives, from think tanks, industry, academia, and government, indicate that urgent and sustained action is required to maintain our leadership. During these difficult economic times, when industry may be forced to cut back basic research investments for short-term survival, it is particularly critical for the federal government to ensure our innovative capacity through basic research and workforce training in science and engineering. The American public agrees: the National Science Board's *Science and Engineering Indicators 2008* reports that according to the most recent NSF survey, in 2006, public support for federal investments in basic scientific research is at its highest level since inception of the survey in 1979.

Overview of National Science Board Activities in FY 2007-2008

The National Science Board is committed to helping this country maintain our leadership in science and technology. Over the past year, in its oversight role for NSF, it has reviewed and endorsed the Office of Inspector General's Semi-annual Reports to Congress and approved the NSF management response; we approved the Foundation's Budget Submission for transmittal to OMB; reviewed the Foundation's annual Merit

Review Report; and provided review and decisions on major awards or proposal funding requests for 13 awards, with a total approved funding of over \$1.08 billion.

The Board also addressed a number of significant policy issues for U.S. science and engineering, in accord with our statutory mission—far more than I will have time or space to describe here. I would like to briefly outline the Board’s conclusions from a number of reports it has issued, and also to present our priorities for the upcoming year.

First, I will highlight some of our major accomplishments, including those activities that specifically address Congressional concerns.

NSF Oversight and Policy Directions

Science, Technology, Engineering and Mathematics (STEM) Education- The Board is working with NSF to implement recommendations in several recent education reports. In October, the Board released *A National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System* in response to a request from Congress. The report outlines a number of actions that local, state, and federal stakeholders can take to improve the nation’s STEM education system. In that report, the Board first recommends greater coherence in the STEM education system, vertically across grade levels and horizontally across States. The second priority recommendation is to ensure that students are taught by well-prepared and highly effective teachers. A number of NSF programs are identified specifically as contributing to the development of human capital in the science and engineering workforce, including STEM teachers. These include Louis Stokes Alliance for Minority Participation (LSAMP), Research Experiences for Undergraduates (REU), the Robert Noyce Scholarship program, and the Math and Science Partnerships program as examples of NSF programs that prepare effective teachers. We are pleased to see that the budget provides additional funds for MSP, the Noyce Scholarship and other programs that contribute to the Board’s objectives for the STEM teaching workforce.

Another report, *Moving Forward to Improve Engineering Education*, recommended a number of actions for NSF to build upon its innovative programs in engineering education to attract, retain, and train American engineers from diverse backgrounds to meet domestic needs and growing international competition.

Transformative Research – Occasionally in the course of scientific research endeavors, a new finding revolutionizes a field or creates new subfields of discovery. The willingness of review panels to take risks on potentially transformative proposals is an area of continual attention at the National Science Foundation in keeping with its mission to support discovery through funding basic research. We recognize that risk aversion in recommendations for funding by review panels is likely to increase as funding becomes increasingly competitive. However, we also recognize that our nation can not afford to miss out on revolutionary ideas. Therefore, the Board formed a task force on transformative research, which issued a report last May entitled *Enhancing Support of Transformative Research at the National Science Foundation*. In the report, the Board recommends that NSF implement a Transformative Research Initiative, and is currently working with the NSF to implement this recommendation.

Implementation of the America COMPETES Act - In response to the America COMPETES Act, the Board has undertaken a number of actions. The Board recently sent reports to Congress to make recommendations on NSF policies regarding cost sharing and on preconstruction and management and operations cost coverage under the Major Research Equipment and Facilities Construction (MREFC) account, and will be preparing a final report for Congress on this subject this year. To briefly summarize the findings of these reports:

- The National Science Board has statutory responsibility for the oversight of activities funded from the MREFC account. It is a substantial challenge to prioritize and manage MREFCs, and the Board is exploring the best solution for ensuring solid analyses of science needs, construction costs, and operations and maintenance (O&M) costs in the "MREFC process" and to define how the Board can contribute in the oversight process. In particular, the Board recommends that

better estimates of lifetime costs be obtained in the pre-construction planning phase of a project.

- A 2004 NSB policy eliminated the cost sharing requirement for research grants and cooperative agreements. The Board recommends changes in the 2004 cost sharing policy, including reinstatement of mandatory cost sharing for certain programs.

I would be happy to meet with you at a later date to elaborate on the Board's policy activities or respond to any questions concerning any or all of these important policy concerns.

The Board is also reviewing the impacts of NSF policies on interdisciplinary research and on limiting the number of proposals per institution of higher education for some awards. The Board will report back to Congress on both of these issues by August 2008. Finally, the Board will evaluate a pilot program of grants for new investigators at NSF and report the findings to Congress by August, 2010.

Advice to the President and Congress

Science & Engineering Indicators – One of the highlights of the year was the recent release of *Science and Engineering Indicators 2008*, which the Board transmits to the President and Congress every even numbered year. It is the most comprehensive series of indicators on the state of the U.S. science and engineering enterprise in a global context. The 2008 Indicators tell a mixed story. A sample of findings include:

- The U.S. is the largest, single, R&D-performing nation in the world supplying an estimated \$340 billion for R&D in 2006, a record high. However, Federal obligations for all academic research (basic and applied) declined in real terms between 2004 and 2005 and are expected to drop further in 2006 and 2007. This would be the first multiyear decline for Federal support for academic research since 1982.
- Basic research accounted for 18 percent of total R&D, or \$62 billion. The federal government supplied about 60 percent of all basic research funds, industry about

17 percent, with private foundations, academic institutions and other governmental entities supplying the rest.

- U.S. grade school students continue to lag behind other developed countries in science and math, although fourth and eighth grade U.S. students showed steady gains in math since 1990. Only fourth graders showed gains in science compared to 1996.
- The U.S. sustained a relative economic advantage over other developed and developing economies. The U.S. is a leading producer in high-tech manufacturing and knowledge-intensive services, but several Asian countries, led by China, have rapidly increased their global market share. The U.S. comparative advantage in exports of high-technology products has eroded: the U.S. trade balance in advanced technology products shifted from surplus to deficit starting in 2002. Information and communications products geographically concentrated in Asia -- particularly China and Malaysia -- account for this deficit.
- U.S. public support for government funding of scientific research is strong and growing. In a 2006 survey, 87 percent of Americans supported government funding for basic research, up from 80 percent in past surveys dating back to 1979. Also, Americans who said the government spends too little on scientific research grew from 34 percent to 41 percent between 2002 and 2006.
- Diversity has increased in the academic science and engineering labor force. From 1973 to 2006, in the academic, doctoral labor force the share of women increased from 9 percent to 33 percent, of underrepresented minorities (African-Americans, Hispanics, and American Indians/Alaska Natives) from 2 percent to 8 percent, and of Asian/Pacific Islanders from 4 percent to 14 percent.

Along with *Science and Engineering Indicators 2008*, the Board has prepared two additional reports: *Digest of Key Science and Engineering Indicators 2008* and a Companion Piece policy statement: *Research and Development: Essential Foundation for U.S. Competitiveness in a Global Economy*. The first report was developed to encourage broad use of Indicators data. It includes a set of 20 important indicators, and is structured for ease of understanding and to provide linkages to more extensive discussions and data in the main Indicators volumes that are related to the selected

indicators. The second, Companion Piece, report expresses Board concerns with industry and Federal investment in U.S. R&D, especially basic research and academic research, and offers recommendations on improving our understanding of global trends in industrial science and technology and implications for the U.S. economy and jobs.

International Partnerships

The Board's Task Force on International Science conducted a series of roundtable discussions and meetings to examine the role of the U.S. government in international S&E partnerships. The task force prepared a report on their findings, which was approved at the December 2007 meeting and will be released in March 2008. The report, *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise (NSB-08-4)*, recommends that the U.S. strengthen S&E partnerships with other countries.

The NSF Office of International Science and Engineering should be more active in encouraging international partnerships between NSF funded Principal Investigators and scientists and engineers in other countries, especially developing countries. In a global world, such partnerships enable us to leverage growing basic research investments in other countries. For example, partnerships would help to share costs of research on common global challenges such as sustainable energy, climate change, natural disasters, disease pandemics, and the fight against terrorism. In addition, the Board believes that S&E partnerships could be utilized more broadly for diplomacy. We also would like to see more formal, high level cooperation in S&E among Federal agencies through NSTC. Opinion polls show that countries with very unfavorable views of the U.S. in general still overwhelmingly admire U.S. science and technology. For example, scientific collaborations with Russia improved goodwill between the countries after the Cold War and helped to ensure that nuclear technology was adequately protected; collaborations with countries such as Iran could serve a similar purpose today.

Hurricane Research – Hurricanes account for over half of total weather-related damage in the U.S. Stimulated by the devastation after Hurricane Katrina, the National Science Board convened a Task Force on Hurricane Science and Engineering. In January of 2007, it unveiled the National Hurricane Research Initiative (NHRI) in the report, *Hurricane Warning: The Critical Need for a National Hurricane Research Initiative*. The proposed NHRI would establish highly focused priorities that involve industry, academia, and government in addressing research gaps and in applying research findings to operations that could help us to mitigate the destructive impacts of future hurricanes.

FY 2009 Budget Request

National Science Foundation

The National Science Board reviewed and approved the FY2009 budget request that was submitted to the Office of Management and Budget. The Board supports the President's budget request. The \$6.85 billion request represents an increase of nearly \$789 million, or 13 percent, above FY2008 levels. The request is the first step toward doubling the budgets of several agencies including NSF, the National Institute of Science and Technology, Department of Commerce, and the Office of Science, Department of Energy, over 10 years and is critical for realizing the goals of the bipartisan competitiveness agenda that will help to maintain U.S. leadership in scientific and engineering research and education.

The NSF already receives many more outstanding research proposals that we can fund, so I assure you that the budget increase will be put to good use. The proposed 13 percent budget increase will provide funding for 1,370 more outstanding research proposals and 3,075 more Graduate Research Fellowships to support our most promising young American scientists – tomorrow's innovators. Support for graduate education is one of NSF's fundamental responsibilities. The Board continues to examine the best ways to financially support the future generation of scientists and engineers during graduate education. Although it is clear that financial support in any form—whether scholarship, assistantship, or traineeship--is important for success in graduate school, the Board continues to consider how the mechanisms for support contribute to the achievement of a

range of objectives for graduate education, including adaptations to ensure American scientists and engineers can compete with scientists and engineers from around the world.

National Science Board

For FY 2009, the request for the National Science Board is \$4.03 million, an increase of \$61,000, or 1.5 percent, over the FY 2008 estimate of \$3.97 million. The FY 2009 budget will allow the Board to strengthen its oversight and policy duties for NSF and to provide independent scientific advice for the President and Congress. In addition, the Board will continue to increase communication and outreach with universities, industry, the science and engineering research community, Congress, federal science and technology agencies, and the public. For example, we continue to engage with numerous stakeholders to implement recommendations from our STEM education action plan.

This year, the Board will continue to expand our role in approving MREFC projects, address the topic of sustainable energy through a series of roundtables, review the NSF cost sharing policy, review the impact of multiple proposals on institutions, and analyze support for interdisciplinary research. In addition, by August 2010, the Board will submit to Congress a report of findings and recommendations on the NSF pilot program of grants for new investigators that was established by the America COMPETES Act.

The Board also has been reexamining the policy for recompetition and renewal of awards at NSF. In 1997, the Board approved a statement on competition, recompetition, and renewal of NSF awards. The Board assessed the implementation of the statement, and issued a statement to reaffirm the 1997 statement at their last meeting. The Board endorses strongly the principle that all expiring awards, including major facility awards, are to be recompeted, and believes that peer-reviewed competition and recompetition is the process most likely to assure the best use of NSF funds for supporting research and education.

One of the most significant activities over the next two years is to plan content for *Science and Engineering Indicators 2010* and to consider whether we should prepare a

second round of the *Digest of Key Science and Engineering Indicators* (that was pilot tested with Indicators 2008) for the 2010 volume of *Indicators*. The Board is already soliciting input on the 2008 Indicators and Digest to determine how we can improve the 2010 version to address the concerns of the various communities who rely on this comprehensive and objective set of data to craft policies that foster discovery and innovation through science and engineering. We will also be presenting the findings of our policy Companion Piece to Indicators to a range of stakeholder audiences to discuss possible responses to our recommendations. To this point we have held two rollout events for Indicators 2008, on Capitol Hill and at the Chamber of Commerce. We have held additional discussions with spokespersons from the Department of Commerce and with the members of the Government-University-Industry Research Roundtable at the National Academies on data issues and policy concerns highlighted in our Companion Piece, *Research and Development: Essential Foundation for U.S. Competitiveness in a Global Economy*.

A priority for the Board during the upcoming year is sustainable energy. In October 2007, the Board established the Task force on Sustainable Energy to address the science and engineering challenges related to sustainable energy. The Task Force held the first of a series of roundtable discussions earlier this month on the role of the Federal government, businesses, non-profits, and other U.S. stakeholders in addressing the S&E challenges of sustainable energy. The Task Force will continue to meet with stakeholders in order to inform a forthcoming report that will contain recommendations for implementing a nationally coordinated initiative in S&E research and education for sustainable energy.

Closing Remarks

The Board strongly recommends that Congress fund in full the President's budget request for the National Science Foundation and for basic scientific research at other agencies. Amidst the great economic and political uncertainty of the moment, the importance of research and development for innovation and economic growth is undeniable. NSF-funded research and education provides the foundation for American scientific and

technological greatness. The economic growth and the quality of life that we enjoyed in the 20th century were made possible in large part by technological discoveries and innovations. In addition, we need science and engineering advances more than ever to tackle some of the greatest challenges that we have ever faced, including climate change, national security, and sustainable energy production.

I understand that investments in science and technology compete with a host of other funding priorities. Though it might be tempting to forego the long-term investments in the face of short-term challenges, neglecting scientific research and education now will have serious consequences for the future of our country. We must bear in mind that investments in our scientific and technological workforce, infrastructure, and basic research are not luxuries – they are critical for long-term prosperity and security. As other countries now actively seek to emulate our success by building their own innovation infrastructures, we must be ever vigilant to enhance our own innovative capacity.

Based on the President's budget request and the appropriations bill from this committee last year, it appears that both parties of Congress and the White House appreciate the importance of scientific research and education for our country. The FY 2009 budget for NSF and for basic science research in other agencies at the level of the President's request can begin to make up for the opportunities that we will miss this year under the FY 2008 omnibus appropriations bill. You have my pledge on behalf of the Board that we will continue to work closely with the NSF Director to ensure that funding decisions continue to provide maximum returns on the taxpayers' investment in our nation's future.

Cited Board Documents

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