

Statement of Dr. Ray M. Bowen
Chairman, National Science Board
to the
Committee on Science, Space and Technology
United States House of Representatives
on
The National Science Foundation's FY 2012 Budget Request
March 11, 2011
10:00 a.m.

Chairman Hall, Ranking Member Johnson, and Members of the Committee, I appreciate the opportunity to testify before you today in support of the National Science Foundation's budget request for Fiscal Year 2012. I am Ray Bowen, Chairman of the National Science Board (Board) and President *Emeritus* of Texas A&M University. In 2002, I was nominated to the Board by President Bush, confirmed by the Senate, and then renominated and confirmed in 2008. I was elected Chairman of the Board by my peers in May 2010. In my experience with the Board during these past nine years, I have been consistently impressed with the quality of research supported, the long reach of National Science Foundation (NSF) activities, and by the dedication and expertise of the agency's staff.

Introduction

On behalf of the entire Board, I would like to thank the Members of this Committee for your long-standing commitment to support of the NSF and its investments in a broad portfolio of research and education in science, technology, engineering, and mathematics (STEM). NSF is the primary source of funding for academic basic research across non-biomedical science and engineering (S&E) disciplines. NSF funds cutting-edge research at the frontiers of knowledge, and also supports scientific facilities and activities in STEM education. During its 60-year plus history, NSF's broad portfolio of investments have underwritten a wealth of research that have directly and indirectly benefitted the American economy and the general public. In light of the many achievements garnered from previous investments in S&E research, the Board urges your strong support for the agency's fiscal year 2012 budget request.

The context for our fervent support for NSF's budget request may be best appreciated within the context of the history of Federal support for basic scientific research. During WWII, Dr. Vannevar Bush led the Office of Scientific Research and Development, and with the strong backing of President Roosevelt, he organized and provided Federal funding for hundreds of research projects in university and industrial laboratories to support the war-time effort. The success of this endeavor precipitated a profound reassessment of the Federal role in national research.

In 1945, Bush published *Science-The Endless Frontier*, which was a treatise on the need for the Federal government to provide regular, peace-time support for both basic research at universities and the education of future scientists through a single new agency. Bush wrote: "The Government should accept new responsibilities for promoting the flow of new scientific knowledge and the development of scientific talent of our youth. These responsibilities are the proper concern of the Government for they vitally affect our health, our jobs, and our national security." Importantly, he noted that "basic research is essentially noncommercial in nature. It will not receive the attention it requires if left to industry." The Bush vision encouraged the mission agencies to support research universities in fields that were deemed to have probable long-term relevance to their missions.

Five years later, in 1950, the National Science Foundation was created. Federal support for science research was encouraged, and with it, unprecedented innovation in the scientific and technological arenas.

Due in large part to NSF's support for S&E research and education, our research universities have become the envy of the world. The application of new knowledge and human capital development in STEM fields resulting from this Federal/academic partnership has indeed created handsome benefits for all Americans. These long-term and often uncertain investments in S&E research and education over a half-century have provided extraordinary dividends for successive generations of our citizens.

In the presence of global competition, our Nation should be strong in all facets of technical innovation and should have available a continuously renewed base of knowledge to inform its decisions and those of its citizens. In order to prosper over the long term, a nation requires several essential building blocks of innovation, including a robust high-tech industry, a well-educated scientific talent base, and a vigorous research community.

Although the Board is very cognizant of the current Federal fiscal constraints that our Nation faces, we are also certain that the unique and long-term value of NSF programs in science and engineering research and education foster the bedrock of our future economic health. This long-term value is the basis of the Board's support for the Foundation's FY 2012 Budget Request.

Concern about US Leadership in S&E

A recurring concern of the Board is the potential loss of U.S. global leadership across the science and engineering spectrum. 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 would be unwise for the U.S. to neglect our science and engineering enterprise.

The United States has long been a leading center of science, technology, and innovation, but we now face challenges as a result of growing capacity in science and technology (S&T) across the globe. Economists increasingly emphasize the central role of knowledge, particularly R&D and other activities to promote science and technology, in a country's economic success. But as recent indicators show us, in our biennial statistical report, *Science and Engineering Indicators 2010* (SEI 2010), many countries and economies have taken steps to open their markets to trade and foreign investment, develop or recast their S&T infrastructures, stimulate industrial research and development (R&D), expand their higher education systems, and build indigenous R&D capabilities. In short, they are developing strategic plans and policy frameworks for increasing S&T capacity, and investing in the requisite infrastructure and workforce to achieve their objectives.

The current status of the Nation's economy makes it imperative that we do not lose ground in the global S&E race. While the United States still leads the world in R&D investments, other countries have continued to increase R&D expenditures at an expanding rate. For example, between 1996 and 2007, China increased its R&D expenditures at a 20 percent annual growth rate. Increased global R&D activity should by no means be viewed as negative. It leads to a dynamic global system of exchange of scientific knowledge and collaboration among diverse researchers, and provides opportunities to build shared international facilities. However, the United States must view increased global capacity in S&T as a call to sustained action to continue robust investments in science and technology.

One of the key returns on investment in science and engineering is the creation of new jobs. The S&E workforce has shown sustained growth for over half a century, and growth is projected to continue into the future. The number of workers in S&E occupations grew from about 182,000 in 1950 to 5.5 million in 2007. This represents an average annual growth rate of 6.2%, nearly 4 times the growth rate for the total workforce.

If innovation in the form of new technologies, goods and services are imported from other countries, our national competitiveness will be affected. The distribution of R&D funds by the U.S. is a direct reflection of our dedication to lead the world in S&E, and it provides insight into the Nation's broad mission priorities. Outcomes and benefits of R&D depend heavily on the total resources devoted to it.

Board Role in Development of the NSF FY 2012 Budget Request

The NSF budget request for Fiscal Year 2012 reflects a clear understanding that investments in science and technology are critical investments that will build America's future. This request acknowledges the critical nature of science and technology to America's long-term economic growth. Federal support for research and education across S&E fields is of special importance in uncertain economic times, especially when private firms are hesitant to invest in long-term research and development projects.

For the past 60 years, the National Science Foundation has played a central role in innovation by catalyzing the development of fundamental ideas across the frontiers of science and engineering knowledge and supporting the people who generate them. As the only federal agency dedicated to the support of basic research and education in all fields of science and engineering, NSF is positioned to strategically stimulate innovative research that connects the science and engineering enterprise with potential economic, societal, and educational benefits. NSF's high-risk, potentially transformative investments will continue to lead the way for the important discoveries, the education of the future science and engineering innovators, and cutting-edge technologies that will help keep our Nation globally competitive, prosperous, and secure.

The Board is intimately engaged with the development of the agency's initiatives featured in its budget request. The Board, primarily through its Committee on Strategy and Budget, with NSF senior leadership participates in the development of the budget from the initial planning stage for the next budget through informal discussions, numerous teleconferences, and final approval of the submission to OMB. In working with the agency on determining priorities, we take into account the priorities of the Administration and Congress. We also bring our experience with the needs and readiness of the Nation's science and engineering community as a whole.

NSF FY 2012 Budget Request

The Board supports the FY 2012 Budget Request in its entirety. We are especially supportive of those programs that reach across disciplines to bring fresh approaches from differing perspectives to tackle some of the greatest challenges of our time. Throughout its history of developing successful collaborations with researchers in many disciplines, NSF is in the best position to bring together the science community to address seemingly intractable problems or controversial ideas at the frontiers of knowledge. The details of these efforts are best left to Dr. Suresh and the agency's senior management to describe.

For the budget request before you today, one specific area I would like to focus on is the Foundation's Agency Operations and Award Management (AOAM) account.

The AOAM account provides the fundamental framework through which the Foundation's science and engineering research and education programs are administered. AOAM funding covers NSF's scientific, professional, and administrative workforce; the physical and technological infrastructure necessary for a productive, safe and secure work environment; and the essential business operations critical to managing NSF's administrative processes and providing high-quality customer service to the public.

The quality of the merit review process greatly depends upon NSF professional staff with the necessary expertise, within and across disciplines, to select and recruit superior reviewers and panelists, and the

outstanding administrative staff to support them. The need for first-class scientific review is very high as just in the last year, NSF staff directed reviews of over 55,000 proposals. Each was thoroughly examined to ensure only the highest quality research would be supported. To sustain this excellence in merit review, the Board urges full funding for NSF's AOAM account.

For the National Science Board Office, the Board requests \$4.84 million, an increase of \$340,000, or 6.6 percent, for FY 2012. This proposed increase will allow the Board to continue to strengthen its national and NSF policy role and in oversight for NSF.

NSB Oversight Role

When Congress established the National Science Foundation in 1950, it defined dual responsibilities for the National Science Board. First, the Board was to oversee the activities of, and establish the policies for, the National Science Foundation. Second, the Board was to serve as an advisory body to the President and Congress on national policy issues related to science and engineering and education in science and engineering. For today's testimony, I'd like to focus on our first responsibility, that of oversight of NSF.

-Merit Review

As you all know, NSF-funded research and education projects are selected through competitive, merit-based review. This is often cited as the 'gold standard' for funding research, and is emulated by many countries as they develop and enhance their own scientific research efforts. Expert panels rely on two criteria to evaluate proposals: intellectual merit and broader impacts.

Every year, the Board reviews the outcomes of the agency's merit review process. In the latest report (for FY 2009), NSF made nearly 10,000 awards with Omnibus funding. An additional 4,620 awards were supported with the \$3 billion of American Recovery and Reinvestment Act (ARRA) funding. With the ARRA funding, NSF reached a 32 percent funding rate in FY 2009, significantly exceeding the 25 percent funding rate in the previous year.

A large number of meritorious proposals are declined each year. Every year, NSF must decline highly rated scientific proposals due to budget limitations. For FY 2009, approximately \$1.3 billion in added funding could have supported the many proposals that merited awards. This represents a substantial lost opportunity in terms of both innovation and job creation.

-MREFC

The National Science Board has statutory responsibility for the oversight of activities funded from the Major Research Equipment and Facilities Construction (MREFC) account. These are high profile, high cost activities that are unique, meaning that they must often be designed and developed without a template. In my time on the Board, the agency has made great strides in overseeing both the design and construction of these critical facilities. It is a substantial challenge to prioritize and manage MREFCs, and the Board invests substantial efforts to review scientific needs, construction costs, and operations and maintenance costs in the MREFC process.

Future operating costs for facilities are considered when the Board decides whether to approve construction of a new facility under the MREFC account. Projects are repeatedly assessed throughout the planning and construction period to ensure accurate awareness of projected operating costs. Beginning with the NSF FY 2009 budget request, the NSF Director instituted a "no cost overrun" policy requiring that the project cost estimate include adequate contingency funds to cover all foreseeable risks, and that any cost increases not

covered by contingency be accommodated by scope reduction. Since implementing the policy for new facilities, NSF has been successful at staying within cost and schedule plans.

In FY 2012, NSF will continue construction of five MREFC account projects: Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO), the Advanced Technology Solar Telescope (ATST), the Atacama Large Millimeter Array (ALMA), National Ecological Observatory Network (NEON), and the Ocean Observatories Initiative (OOI). All five MREFC projects in the 2012 Request have been reviewed and recommended for funding by the Board. The Board continues to work with agency senior management to improve the process for selecting and managing the MREFC account.

-NSF Strategic Plan for FY 2011-FY 2016

NSF senior management worked closely with the Board in developing its new strategic plan. The plan, “*Empowering the Nation through Discovery and Innovation*,” establishes an overarching vision for NSF’s role in the Nation’s innovation enterprise, challenging the agency to set its sights high.

The three major goals outlined in the strategic plan emphasize the unique role of the agency. The first goal, *Transform the Frontiers*, embraces support for the fundamental, interdisciplinary, high-risk, and transformative research and education that NSF has pioneered. The second goal, *Innovate for Society*, links the results of fundamental research to national and global policy areas where science and engineering play a significant role. The final goal, *Perform as a Model Organization*, sets high standards for attaining excellence in operational activities, promotes a culture of integrity and accountability, and encourages new approaches to assessment and evaluation of NSF’s investment portfolio.

-The America COMPETES Act

The 2007 reauthorization of NSF, commonly referred to as the America COMPETES Act, recognized the critical role the agency plays in maintaining the Nation at the forefront of research. With COMPETES, Congress recognized that the Federal Government must increase its investment in basic research and in science and math education, stating as the purpose of the Act “to invest in innovation through research and development, to improve the competitiveness of the United States and for other purposes.” On behalf of the National Science Board, I want to reiterate the key role that science advancement plays in furthering the Nation’s economic base. The Board intends to continue its oversight of NSF awards to ensure the national treasure is invested productively.

The America COMPETES Reauthorization Act of 2010 requires the Board to report to Congress on the mid-scale instrumentation needs of the science and engineering communities. The Subcommittee on Facilities is in the process of collecting background data and consulting with experts throughout the Nation’s science and engineering community about future instrumentation needs. The report is due in January 2012, and NSB expects to submit its final report by that time.

-ARRA

The National Science Board has taken particular interest in overseeing the \$3 billion provided to the agency in the 2009 American Recovery and Reinvestment Act (ARRA, stimulus). The stimulus funding represented nearly 50 percent of the agency’s annual budget, and the Board, acting in its oversight capacity for the agency, endeavored to ensure the additional funds were well spent.

NSF management set up an overall framework for ARRA investments which emphasized sustainability and innovation. Management determined that grants would be allocated with varying durations. This would allow the agency to structure a sustainable portfolio with requests for renewal of projects staggered through the years. To encourage innovation, NSF management prioritized the funding of new principal

investigators and funding of high-risk, high-return research. Because NSF has a large number of highly rated proposals that it is unable to fund, the agency used the majority of the funding to support those meritorious proposals which had already had been submitted, reviewed, and found to be deserving of funding, though available funds were insufficient to support them until ARRA funds were made available.

For every Board meeting since ARRA was enacted, NSF has provided detailed updates on its disposition of this special category of funding. NSF skillfully managed this new responsibility, making timely awards in concert with the law's requirements. Funds had to be distributed quickly to meet the intent of the stimulus, and NSF was one of the most successful agencies in meeting this goal. In addition, stringent reporting requirements from the awardees was another mandate of the stimulus, and NSF, working closely with the community, developed a robust reporting process that has seen more than 99 percent of awardees submit their results on time.

Closing Remarks

As our Nation recovers from economic recession, investments in science and engineering research and education are ever more critical to laying the long-term foundation for S&T-based innovation that drives the creation of new jobs and industries. The economic growth and the quality of life that we enjoyed in the 20th century were made possible in large part by scientific discoveries and technological innovations. Continued economic prosperity will require continued Federal investments in science and engineering research and education.

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. 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.

This is a difficult time for Federal budgets for S&E research and education and the institutions and individuals in the nonprofit and public sectors that rely on Federal support. The Federal government has sustained a continual, visionary investment in the U.S. research and education enterprise in the expectation that such investment would benefit all Americans. That Federal effort has expanded the horizon of science and engineering discovery and achievements far and wide, leading to the realization of enormous benefits to our Nation.

In recognition of our current Federal fiscal realities, the National Science Board will ensure that NSF sets priorities, makes hard programmatic budget decisions and, as a result, obtains the greatest benefit from the funds provided. However, even in a time of budget constraints, as a Nation we cannot ignore our growing dependence as a society on innovation for economic prosperity and the ever-improving quality of life Americans have come to expect. The Federal compact in research and education with the nonprofit sectors is an essential pillar of our Nation's global dominance in S&T.

On behalf of the National Science Board and the S&E research and education communities, I would like to thank the Members of the Committee for your long-term recognition of and commitment to support for the National Science Foundation. We look forward to continuing our productive working relationship with you in service to the Nation.