Testimony of
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National Science Board

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Introduction

Chairwoman Comstock, Ranking Member Lipinski, and members of the Subcommittee, I appreciate the opportunity to speak with you today in support of the National Science Foundation's Fiscal Year 2016 Budget Request. I am Dan Arvizu, Chairman of the National Science Board (NSB, Board) and Director and Chief Executive of the Department of Energy's National Renewable Energy Laboratory. NSB is the governing Board of the National Science Foundation (NSF) and an independent advisor to Congress and the President. I have served on the Board since 2004 and was elected Chairman of the Board by my peers in 2012.

Before beginning, I would like to comment on NSF Director France Córdova. Dr. Córdova has been at the agency's helm for nearly a year, and the Board is very appreciative of and impressed by her leadership. She should be commended for her focus on strengthening NSF as an institution. From day one, her work has been dedicated to ensuring that NSF supports and will be able to continue to support the strongest portfolio of discovery research in the world. Dr. Córdova has been attentive to both processes and people, placing herself at the forefront of the Foundation's efforts to enhance transparency and accountability and continuing to focus on strengthening the Foundation's workforce. Dr. Córdova is a terrific ambassador for the agency, domestically and internationally, connecting with scientists across all fields so that NSF can achieve its mission of identifying and funding the best work at the frontiers of science.

Core of NSF: Basic Research

NSF's mission is to enable the pursuit of unfettered discovery science. For 65 years, NSF has demonstrated that federal support of such science – that is, science without a known application at the time of its initial pursuit – is squarely in the nation's interest. Fundamental science funded by NSF has yielded knowledge that has changed our understanding of the world around us, led to advances and applications that have improved our quality of life, enhanced our health, and helped secure our national defense. This commitment to discovery science – a commitment

unlikely to be undertaken by any entity other than the federal government – has propelled the U.S. economy to global leadership in science and innovation and has been a building block of our nation's prosperity in the post-World War II era. Chairwoman Comstock, on behalf of my 24 colleagues, and the science, engineering, and education communities which we represent, I'd like to thank members of this Subcommittee for their long-standing support of NSF's mission. My colleagues on the Board and I recognize that these are tough fiscal times, and we do not take your support for granted. To this end, the NSB takes very seriously its responsibility to provide strong governance and proper stewardship of this taxpayer investment.

NSF's mission of discovery science exists at the core of a much larger national science and technology ecosystem that serves the national interest. NSF drives early stage research in all scientific fields, laying the knowledge foundation that makes possible the application-oriented science pursued at other agencies and the technological innovations developed by the nation's businesses. NSF has done its job when other entities can build upon or find applications for this knowledge. In order to fuel this entire ecosystem, NSF's discovery research – of necessity – has cross-cutting themes and disciplinary overlap with the domains (but not necessarily the research stages) of other federal science agencies. Let me illustrate this through a few examples.

Nearly a decade ago, NSF – recognizing that the electricity sector was insufficiently focused on security – invested in early stage research on how to design and build a secure cyberinfrastructure for the power grid. This research, sponsored by NSF's Computer and Information Science and Engineering (CISE) Directorate, has since been carried forward with funding from the Department of Energy's Office of Electricity Delivery and Energy Reliability (DOE-OE) and the Department of Homeland Security Science and Technology Directorate. Today, the Trustworthy Cyber Infrastructure for the Power Grid Project (TCPIG) is collaborating with national laboratories and the utility sector to improve the design, security, safety, and resiliency of the U.S. power grid. Thanks to these successive federal investments, the group's technologies are being piloted in real utility environments and their work has become foundational technology for three start-up companies.

Another example demonstrates the power of cross-agency, multi-disciplinary research. A joint initiative between NSF's Division of Mathematical Sciences (DMS) and the National Institute of Health's National Institute of General Medical Sciences (NIGMS) supports research at the interface of the Biological and Mathematical Sciences. The spread of infectious diseases from wildlife to humans is on the rise, with last year's historic Ebola outbreak a recent example. Factors that affect such outbreaks include the density of human and wildlife populations, changes in land use, and human behavior. The joint DMS and NIGMS Initiative has supported work on Ebola, fostering collaborative research projects that leverage the contributions of disease ecologists, epidemiologists, mathematicians and economists to better understand this and other rapidly evolving infectious diseases.

Examples such as these underscore that cross-cutting research and federal support for different aspects and phases of scientific research help NSF investments reach full fruition.

NSF's research priorities are developed through a long-established bottom-up process that begins with the scientific community. Community priorities are identified in a variety of ways – through

the grant making process, through the work of NSF's advisory committees, through National Academies' reports, and through crowdsourcing ideas directly from NSF's principal investigators. These ideas are vetted and prioritized at every level of NSF leadership – programs, divisions, directorates, and the Office of the Director – always with an eye toward advancing science and the Foundation's mission. The NSB – primarily through its Committee on Strategy and Budget that is chaired by former AAAS CEO Dr. Alan Leshner – provides input to the Foundation's leadership as these research priorities are put into the agency's budget. When the Board approves NSF's budget submission, our goal is to ensure that the scientific priorities are sound and consistent with the Foundation's mission, while not squelching the creativity of the scientific community or undercutting the bottom-up priority setting processes that have served our nation so well.

FY 16 Budget Request

The NSF's FY 2016 Budget Request reflects a strategic commitment to supporting the best basic research, economic growth, job creation through innovation, and a globally competitive science and engineering workforce. The Board believes that the priorities in this proposal reflect a clear commitment to investments that will strengthen our nation over the long-term.

NSF's budget request for its Research and Related Activities account is the result of priorities set by the scientific community, NSF management, and the Board, about where the most fertile national and global research challenges lie. This request includes support for research across all fields of science and engineering, which the Board endorses as necessary to fulfill NSF's mission to advance the national health, prosperity, and welfare, and to secure the national defense. This flexibility allows NSF to fund the best research opportunities, regardless of field. For instance, over the past fifteen years, computing research has grown significantly in response to opportunities created by cyberinfrastructure and big data. Interdisciplinary science, which is often at the frontier of new knowledge, is also playing a more prominent role in fostering advances in discovery science.

I would like to also highlight NSF's Agency Operating and Award Management account, known as AOAM. This account covers NSF's scientific, professional, and administrative workforce; the physical and technological infrastructure necessary for a productive, safe and secure work environment; NSF's relocation to Alexandria, Virginia, and the essential business operations critical to managing NSF's administrative processes and providing high-quality customer service. AOAM is lean – in FY 2015, it accounted for only about 6 percent of NSF's budget.

The requested budget for AOAM would allow NSF to bring on additional staff to meet the requirements of the Digital Accountability and Transparency Act and build a digital service team. This will enable the agency to support high quality, transparent federal spending information and transform NSF's digital services, making them easier to use and more cost-effective.

For the National Science Board, we are requesting $4.37 million – unchanged from the current fiscal year – to meet our oversight responsibility of NSF's performance and fiscal integrity and

to work with the Director to capitalize on the opportunities continually arising from the expanding frontiers of scientific knowledge. The Board, through its Audit and Oversight Committee chaired by Dr. Ruth David, president and chief executive officer of Analytic Services, Inc., also works with the agency's Office of the Inspector General to ensure American taxpayers receive the best scientific research in the Nation in return for their investments. NSF's great successes are a tribute to the NSF staff whose excellent work and deep commitment to the mission of this agency is truly inspiring.

Focus Areas and Board Activities

Assessing the U.S. science and engineering enterprise

Access to high quality data, and associated thoughtful critical analyses of it, are essential first steps for decision-makers across government, business and education to craft policies that address our nation's challenges and opportunities in the STEM education and workforce arenas. Providing comprehensive, high quality, accessible data is one of the chief contributions of the National Science Board and its Committee on Science and Engineering Indicators led by Dr. Kelvin Droegemeier, vice president for research at the University of Oklahoma. The Board's congressionally mandated biennial *Science and Engineering Indicators* report – along with a suite of related resources – provides comprehensive data and findings on educational and workforce issues and insights on areas where we can and must do better as a nation. The Board will soon be releasing a policy report that revisits the U.S. STEM workforce and provides a new perspective on how we view both STEM education and training opportunities as well as the nation's job landscape.

Working to enhance time spent on discovery

Another area where we see both opportunities and challenges is that of addressing the administrative burdens placed on federally supported researchers. We share the Subcommittee's concern that administrative tasks related to the increasing number and complexity of federal regulations may unnecessarily be consuming taxpayer dollars and time that our nation's scientists, engineers, and educators could otherwise devote to federally sponsored research. As a result, the Board created a Task Force on Administrative Burdens led by Dr. Arthur Bienenstock of Stanford University. Last year, this task force released a report that assessed current requirements on Federally-supported researchers, and offered recommendations on relieving the administrative workload. The Board is very pleased that its report has been helpful to bipartisan, legislative efforts to address this important issue. NSB will continue to work to help advance progress in this area, and we look forward to working with you to increase efficiency, reduce red-tape, and obtain more research per taxpayer dollar.

Managing risk and balancing the dual needs for large facilities and research

I would like to turn to another Board priority area. NSF's large research facilities advance science and engineering, help maintain U.S. competitiveness, and deliver substantial economic benefits to the nation. Their size and long-term commitment demand priority setting, frequent

assessment, and careful management of risks. The National Science Board, through its Subcommittee on Facilities and its Committee on Programs and Plans, chaired respectively, by Dr. Carl Lineberger of the University of Colorado and Dr. Anneila Sargent of Caltech, plays a strong and active role in this area. Although each and every one of these large projects has grown out of a lengthy science-driven prioritization process, and includes the Foundation's internal review boards, Large Facilities Office, and Major Research Equipment and Facilities Construction (MREFC) Panel, which scrutinizes plans and budgets every step of the way, approval of these projects ultimately comes from the Board. We approve, oversee, and conduct careful review of large facilities at all life cycle stages.

The Board's Annual Portfolio Review looks at NSF's Facilities Portfolio in its entirety and upcoming changes to it. It is attentive to the balance within divisions and directorates and includes an assessment of the trade-offs between large facility maintenance and usage and NSF's support of core research. Recent Board meetings have featured in-depth updates from the agency about the significant progress it is making in clarifying the careful internal and external processes involved in management of its large facilities.

As you know, cooperative agreements play an important role in this arena and the Board and Director have heard concerns about these agreements from the Inspector General. NSB and the Director plan to jointly commission an external, independent review to assess how NSF manages cooperative agreements, and to explore areas where we might improve our procedures. We will give serious consideration to any recommendations that come out of this evaluation.

Accountability and transparency are needed at all federal agencies. NSF is always looking to improve our processes and results. Among recent efforts are reducing regulatory burden through innovative pilot programs and new guidelines to implement nontechnical abstracts that describe how a project serves the national interest. Embracing improvement and transparency are changes we believe will make NSF better and stronger in the long-run and Director Córdova deserves recognition for her attention and leadership in this arena.

Conclusion

In closing, Chairwoman Comstock, I would like to again thank Subcommittee members for their leadership on science and engineering issues.

My colleagues and I understand that, like all Americans, the research community must be willing to make tough choices and set priorities. This is a challenge that my colleagues and I, along with the Director, have embraced, as we understand that it is our responsibility to obtain the best return on the taxpayers' investment.

Even in a time of severe budget constraints, the Board believes that investments in fundamental discoveries, in STEM education, and in our nation's S&E workforce are essential to the nation's long-term prosperity and security.

The Proverbs quote in the House Science, Space and Technology's hearing room perfectly captures the sentiment behind discovery science: "Where there is no vision, the people perish."[1] As you consider NSF's future budgets and priorities, I hope you will remember that discovery requires foresight, daring, and long-term commitments. Congress has always recognized this, and as a result NSF has steadily advanced the frontiers of science. Our researchers, ships, observatories, and long-running surveys have led to revolutionary technologies, Nobel prizes, and even a new state of matter. These tremendous accomplishments are the results of 65 years of partnerships among scientists, universities, the NSF, and Congress.

Thank you for your willingness to engage and respond to the community on NSF reauthorization efforts, for your leadership, and for the opportunity to testify.

[1] Proverbs 29:18.