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Chairman Lipinski, Ranking Member Ehlers, and other distinguished Members of the subcommittee, thank you for the opportunity to speak with you today on the state of research infrastructure at our nation's research universities.

My name is Leslie Tolbert. I serve as the Vice-President for Research, Graduate Studies, and Economic Development at the University of Arizona, in Tucson, Arizona. I am honored to have the opportunity to offer testimony on behalf of the University of Arizona, the Association of American Universities, and the Association of Public and Land-grant Universities.

Overview

Our nation's research universities are falling behind in their ability to provide the physical infrastructure – both the laboratory buildings and the high-end technical facilities in those buildings – needed to keep our researchers working at full capacity. As state and private sources of funding dwindle, even more quickly during the current economic slump, federal support is growing in importance. Strategic investments in research infrastructure by the federal government are absolutely essential to maintaining a global leadership position for U.S. science. The University of Arizona, with its sharply declining support from the state, provides a useful model for understanding the current

situation in a large public research university and the specific remedies that federal resources could provide.

Background and Context

Funding for University-based Research

The record of research accomplishment of U.S. universities is astounding. For the past 60 years, at least, these accomplishments have been the backbone of our economic competitiveness, high living standard, and national security. As documented in the National Academies "Rising Above the Gathering Storm" report, our leadership position in education and innovation has been threatened in recent decades as other countries have sought to emulate us by making huge investments in their research enterprises. U.S. leadership in science and engineering will be maintained only if we maintain a modern and effective research infrastructure.

For many decades, the federal government has assumed the responsibility of providing the dominant support for university-based research and research training, providing billions of dollars in support, virtually all of it on a competitive basis to ensure that the most meritorious research ideas receive funding. Our system of competition through review and ranking of applications by peers is the envy of the world.

In recent years, however, federal support of university research in science and engineering, while still substantial, had become essentially flat in real dollars (AAAS Report XXXII *Research and Development FY 2008*, Chapter 2: *Historical Trends in Federal R&D;* http://www.aaas.org/spp/rd/08pch2.htm), even while that of other countries was growing. The American Recovery and Reinvestment Act of 2009 has provided much needed federal funding to reverse this trend for two years, but it is unclear what the picture of federal research support will look like after ARRA funding ends.

Adding to the problem, as the states have faced growing economic challenges, state support for research-related expenses in many public universities has declined

precipitously, and charitable giving and endowment returns to both public and private institutions have also fallen sharply (Council for Aid to Education, http://www.cae.org/content/pdf/VSE_2009_Press_Relsease.pdf, and National Association of College and University Business Officers, http://www.nacubo.org/Documents/research/2009_NCSE_Press_Release.pdf). As a result, American research productivity and scientific advances are likely to diminish. The private sector spends more than twice as much as the federal government spends on research and development (National Science Board, *Science and Engineering Indicators 2010*), but in tight economic times, private industry is driven increasingly to focus its research dollars on applied research and development for short-term profit, leaving to the universities the basic research – and unexpected discoveries – that ultimately must form the basis for future applications.

Maintaining America's universities' competitiveness in fundamental research and research-enriched education has become a serious challenge. Meeting this challenge will require strategic investments in the physical infrastructure for research as well as in the research and educational activities themselves.

Funding for Physical Infrastructure for Research in Universities

The physical infrastructure for research includes not just bricks-and-mortar buildings, but also research instrumentation and a robust cyberstructure (for internal and external communication and for research requiring high-performance computing). The increasing complexity of science and engineering requires advanced technical equipment and tools, as well as specialized workspaces that encourage and enhance collaboration and inter-disciplinary pollination of ideas.

The physical infrastructure that must be in place for cutting-edge research was historically provided by a combination of federal and state government and university funds. Federal dollars for infrastructure have decreased, however. As described by Homer Neal, Tobin Smith, and Jennifer McCormick in their book, *Beyond Sputnik – U.S. Science Policy in the 21st Century* (U. Mich. Press, 2008):

> *"In the years following World War II and immediately after Sputnik, the US government invested heavily in the development and funding of scientific infrastructure at universities, national laboratories, and other federal research facilities. However, by the early 1970's many federal programs that had previously existed to support construction and renovation of research facilities ended, and federal obligations for research facilities and large equipment in colleges and universities dropped significantly. During this period, the neglect of laboratory instrumentation and the erosion of the physical infrastructure for research threatened the long term vitality of even leading universities."*

Today, federal dollars are directed primarily to supporting research operations, with little targeted directly to the costs of providing the necessary research infrastructure. To fill this gap, universities have relied heavily upon state support, endowments, gifts, and other institutional resources to support their physical research infrastructure needs. However, declines in state support for public universities and in endowments and gifts for public and private universities, have made it increasingly difficult for us to sustain and renovate existing laboratories or to build the new facilities that are required for increasingly sophisticated research.

As a result, universities are falling behind the need to provide the physical facilities to do the research that will propel our economy forward. According to the National Science Board's 2010 report of "Science and Engineering Indicators:"

> *"Research-performing colleges and universities continued a two-decade trend of increasing the amount of research space at their institutions. […] In recent years though, the rate of increase in research space has begun to slow. […] The rate of increase peaked in FY 2001–03 at 11%. Since then, the rate of increase has gradually declined. […] In conjunction with the slowdown in the increase in research space, the total amount of newly constructed research space also began to slow at the beginning of the decade (table 5-5). Since FY 2002–03, the total amount of new research space constructed declined by approximately 45%."*

Current Situation Regarding Federal Support for Research Infrastructure

The federal government provides support for research infrastructure in several ways. Some support for research facilities comes through the provision of Facilities and Administration (F&A), or "indirect," cost recovery that is included in grants and contracts awards. F&A cost recovery is intended to reimburse universities for expenditures on the buildings, utilities, equipment, libraries, and administration that collectively support their research.

A large portion of the funds awarded for F&A costs are, in fact, *not available* for the kinds of infrastructure projects I have mentioned. Most notably, growing federal mandates and research compliance requirements have pulled institutional funds away from support of research facilities. A 2004 report from the Council on Government Relations ("A New Research Business Model: Incentivizing Research") points out that universities actually provide significant cost-sharing:

> *"Universities contribute to the direct costs and the indirect (i.e., F&A) costs of federal research. The National Science Foundation's (NSF) annual survey on Research and Development (R&D) Expenditures at Universities and Colleges shows the significant and increasing financial contributions made by all colleges and universities, in total, to the research enterprise over the past sixty years. […] when shown as a percentage, the important role of Institutional Funds is clear. Over the period from 1976 to 2006, the share of R&D expenditures in this category has grown faster than any other category. According to the 2006 NSF Survey, Institutional Funds account for 19.0% of all R&D expenditures, compared to 12.0% of all R&D expenditures in 1976. To put this in another context, the increased share from 12.0% to 19.0% represents a growth factor of 58%."*

In addition, there are a limited number of federal mechanisms designed specifically to fund research infrastructure. These include NSF's Major Research Equipment and

Facilities Construction (MREFC) program and their Major Research Instrumentation (MRI) program; NIH's Shared Instrumentation Grants and High-End Instrumentation Grants; the NCRR Animal Facility, Research Facility Improvement (C06), and Core Facility Renovation, Repair, and Improvement (G20) programs; research facility construction funds from the National Institute of Standards and Technology; and the Department of Defense's University Research Instrumentation Program. Some of these infrastructure programs and their scopes were temporarily expanded with the use of American Reinvestment and Recovery Act (ARRA) funds. One program that was revived with ARRA funds was the NSF's Academic Research Infrastructure (ARI) program, which I will discuss further in my recommendations.

How the University of Arizona Supports Research Infrastructure

At the University of Arizona, one can see firsthand the impact of all the aforementioned issues, including the precipitous decline in state funding as well as the shrinking funding for research infrastructure from federal sources. I think you will find the UA to be a useful case study.

The University of Arizona is a large, comprehensive land-grant university that includes, together on one campus, liberal arts colleges and colleges of medicine, pharmacy, nursing, public health, engineering, optical sciences, and law. On a separate campus, we have a Science and Technology Research Park. We are one of the top 25 research universities in the nation and a member of the Association of American Universities. In FY 2008, our Science and Engineering Research and Development expenditures amounted to $546 million; we were ranked #1 in total R&D expenditures in physical sciences by the NSF. Approximately 27% of our operating expenses are in support of research.

In FY 2010, 22% of UA revenues were from state-appropriated funds; 27% were from student tuition and fees; and the remaining 51% were from other sources, including sponsored grants and contracts, auxiliary funds, gifts, and investment income. [See

Table 1 below.] Each year, sponsored grants and contracts come primarily from the federal government, with the remainder from industrial sponsors, foundations, and private contributions. Among federal sponsors, the Department of Health and Human Services (HHS) provides the largest single share of sponsored grants and contracts (primarily via the National Institutes of Health), followed by NASA, National Science Foundation, Department of Defense, and Department of Agriculture.

Table 1 – University of Arizona Funding Sources	1999-2000 (Actual) in thousands		2009-2010 (Budget) in thousands	
State Support	$320,912	34%	$348,941	22%
Net Tuition	$128,929	14%	$311,464	19%
Tuition Funded Aid	$ 31,722	3%	$123,747	8%
Grant & Contracts	$291,604	31%	$537,504	33%
Ancillary Units	$ 91,509	10%	$157,792	10%
TRIF *	$ 0	0%	$ 21,645	1%
Gifts & Endowments	$ 37,294	4%	$ 54,058	3%
Investment Income & Other	$ 36,532	4%	$ 63,860	4%
TOTAL	$938,502	100%	$1,619,012	100%

* Technology Research Infrastructure Fund (TRIF) supports university research, development, and technology transfer related to the knowledge-based global economy through a six-tenths-cent increase in state sales tax.

To date, we have been awarded $83.7 million (including anticipated year 2 amounts) in ARRA federal stimulus funds for a wide range of important projects on topics ranging from solar electric materials to optical imaging methods for cancer detection to methods

for monitoring soil moisture in arid lands. Most of the ARRA support is for research projects; $4.7 million from the U.S. Department of Commerce supports a new biotechnology park; and just under $1 million from NSF is for research equipment.

Another federal funding source from which we will receive support in the near future is the MREFC program at NSF. We will serve as the Southwest's core site for the National Ecological Observatory Network, or NEON, for regional- to continental-scale ecological research. The project has recently passed its Final Design Review and the President's FY 2011 budget proposes $433M in MREFC funds to begin the construction phase of NEON. The exact amount of funding that will flow to the UA is not yet determined.

In contrast to federal funding, State of Arizona support of its public universities has fallen steeply in the last two years, precipitating a crisis deeper than any other in recent history. As shown above in **Table 1**, the percent of the UA budget that comes from the state has fallen from 34% to 22% in the past decade. **Table 2** below shows the dramatic decline in just the last three years, from $443 million appropriated to the UA in FY 2008 to $348 million appropriated in FY2010.

Table 2 – State of Arizona University System – General Fund Appropriations	FY 2008 (original budget)	FY 2009	FY 2010
Arizona System (3 public universities and system office)	$1,121,095,300	$938,248,800	$901,652,800
University of Arizona portion	$443,343,400	$362,544,900	$348,496,800

Our research buildings range from modern and well-equipped to outdated and deeply in need of maintenance. The university was founded in 1885, and most of our science related buildings were built in the 1960's through the 1990's. Our older buildings do not meet current safety codes, limiting their utility for research involving hazardous

biological or chemical agents. With their small, compartmentalized spaces, they certainly are not conducive to current modes of collaborative research. We struggle to find the resources to update those buildings, as well as to build new research buildings that can provide the new lab space that we need.

We received no State of Arizona funds for new building projects between the early 1980's and FY 2008. House Bill 2529, signed into law in 2003, provided significant relief in the form of state appropriations of over $440 million for Research Infrastructure Financing for the three state universities over 23 years (FY 2008 – FY 2031). From HB 2529, the UA receives $14 million per year for debt financing. **Table 3,** below, shows the sources of funding for our ten most recently constructed research buildings.

Table 3 – University of Arizona Research Building Projects – by Funding Source	4 New Buildings (2000-2005)		6 New Buildings (2006-2009)	
Debt Financed *	$26,818,000	52.2%	$190,512,000	83.7%
Institutional Funds	$ 6,272,000	12.2%	$ 6,393,000	2.8%
Gifts & Endowments	$ 15,671,000	30.5%	$ 24,288,000	10.7%
Federal Grants	$ 1,940,000	3.8%	$ 6,301,000	2.8%
Other Grants	$ 722,000	1.4%	$ 0	0.0%
Total	$51,423,000	100%	$227,494,000	100%

* Source of debt service payments: Student retained collection, State appropriations, Indirect Cost Recovery, Technology Research Infrastructure Fund from state sales tax increment

A major shortage of state support for Building Renewal at the universities contributes to the challenges of using existing aging buildings for research. The state has a formula for

calculating Building Renewal needs based on the replacement values and ages of our buildings. The state provided only partial funding for the universities' Building Renewal needs in 1987-2001, and has failed to provide any Building Renewal funds for 8 of the past 9 years. Over the past five years, FY 2006 – 2010, we should have received $200 million. Instead, we received only $10.9 million, in FY 2007, thus falling short by $178 million for this period alone. Added to the shortfalls from before 2001, this leaves the UA with an accumulating Building Renewal need that far exceeds $200 million in FY 2010. Old chemistry and engineering buildings are in particular disrepair and can not be used for most types of research in their nominal fields.

In sum, it has become clear that the state cannot fund the improvements needed to keep pace with emerging research needs, and the university struggles to fund the improvements needed to comply with general laboratory safety codes as well as emerging research needs. To guide that struggling effort, the UA has a Space Committee, chaired by the Provost and the Senior Vice President for Business Affairs. The Committee plans building renewal and construction, assessing and balancing research infrastructure needs against the availability of funding and a university-wide commitment to safety and environmental stewardship.

Our conceptual framework for efficient, cost-effective campus build-out addresses several key issues:

- We have accepted an urgent mandate to protect the environment even as we continue to build. When addressing space needs, we first consider refurbishment of old buildings. Often it is too expensive to upgrade existing research facilities, so older research space is converted to offices and classrooms instead. When new buildings are needed, we are committed to building them to at least LEED silver specifications, which is more expensive in the short run but will provide future energy savings to help offset the expense. For laboratory research buildings, which use more energy than office buildings, these savings over time can be great.
- We build out the campus utility infrastructure sector by sector, rather than building by building, in accordance with our campus master plan and capital improvement plan

for the coming 5-10 years. This coordinated approach is very economical, allowing the infrastructure and new buildings to be constructed as efficiently and inexpensively as possible. For example, we have applied for a $15M NIH C06 ARRA grant to build a new research building for imaging sciences. The building construction cost and schedule are greatly reduced because utility infrastructure is already in place. Thus, any funding received will be most effectively used for its core research-support purposes.

- New laboratory buildings generally have a flexible open-laboratory design. This is economical, promotes collaboration among research groups, and allows space for particular projects to grow and shrink as funding waxes and wanes, without the expense of moving walls or utility spines. This approach leads to research funding and discovery successes that would otherwise not occur. Within a few years of the opening of our new open-configuration, interdisciplinary life sciences building, our faculty landed a $50M NSF grant (the largest ever to an Arizona institution) to support collaboration of molecular plant biologists, ecosystems biologists, information scientists, earth-imaging specialists, and others to tackle Grand Challenge problems in plant biology.
- Shared equipment facilities are preferable to facilities under the control of individual researchers. At the centers of our new open-lab buildings are shared core facilities for the most expensive instruments they need, such as those for microscopy, genomic and proteomic analysis, and high-end computing. These core facilities are an economical way to provide large numbers of researchers access to the latest equipment, equipment that they could not afford on their individual grants.

The UA has built ten new research buildings in the past ten years and our Capital Plan includes plans to build three more in the coming two years, to meet our most urgent projected needs. One of these, a research support building for our new College of Medicine arm in Phoenix (in partnership with Arizona State University), will be funded primarily with ARRA funding through an NIH C06 award. Incidentally, the development of that entire medical campus has been a collaboration of many entities dedicated to

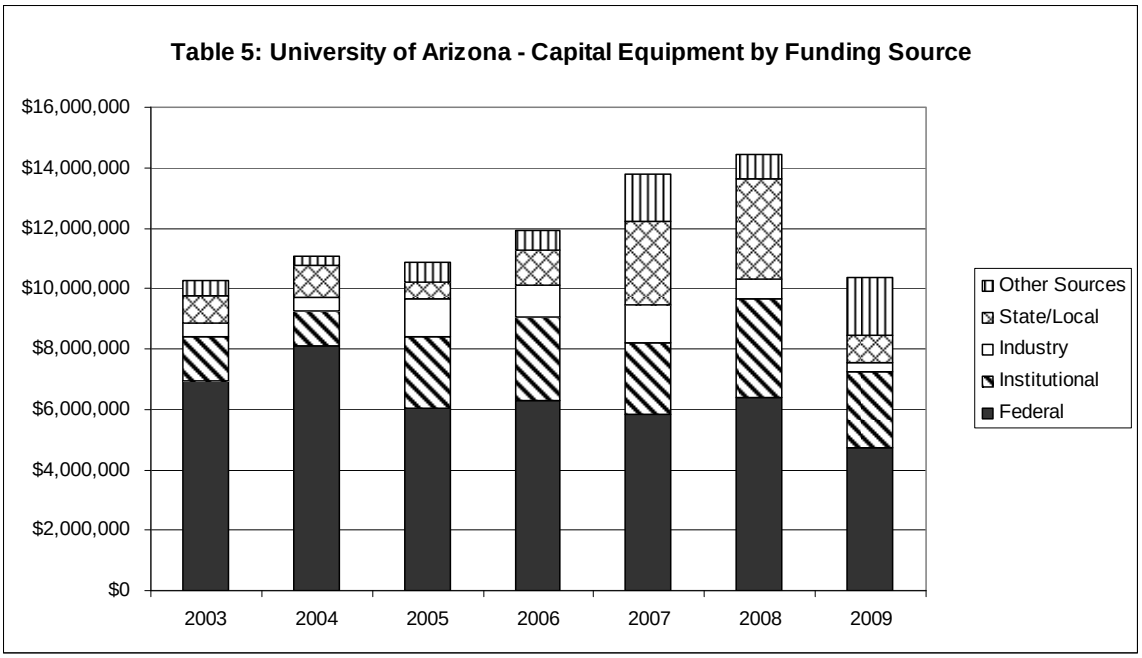
research advancement, including the UA, the City of Phoenix, and public-private partnerships.

Our recently constructed buildings, in both Tucson and Phoenix, are funded by a combination of state and local funds. Projected sources of funds for the next three new research buildings and for research-related renovations on our Capital Plan are shown in **Table 4**, below. We take advantage of the State of Arizona's recently approved Stimulus Plan for Economic and Educational Development (SPEED), a creative mechanism whereby the State will provide 80% of annual debt service payment from state lottery funds, while the universities will cover 20% of the annual debt service payments through institutional funds (which include student retained collections; State appropriations; and indirect cost recovery). Indirect cost recovery alone will be expected to cover approximately 10% of the debt service.

Table 4 - University of Arizona Sources of Funding for Future Projects	SPEED *	Gift Funds	Federal Funds **
New Research Buildings	$466,000,000	$12,200,000	$15,000,000
Building Renewal	$ 57,600,000	$0	$0

* State of Arizona's Stimulus Plan for Economic and Educational Development
** From recently approved NIH C06 award (ARRA funding)

In addition to building renewal and construction, we track our expenditures on capital equipment (item cost >$5,000). While the total investment in capital equipment varies year to year, the percent contribution from federal funds has declined systematically in recent years, from 68% in FY 2003 to just 46% in FY 2009. [See **Table 5** below.] Thirteen percent ($10 million) of our equipment purchased with federal funds in the past ten years has been purchased with funds designated for shared-use instrumentation.



"Capital Equipment" as defined in the University of Arizona's rate agreement and OMB Circular A-21

In addition to our primary campus in Tucson and second medical campus in Phoenix, we have a Science and Technology Park in the outskirts of Tucson. With more than 7,000 employees, the UA Tech Park reflects one aspect of our partnership with the private sector in regional development and is one of the region's largest employers. It is home to 40 high-tech companies and business organizations, including several emerging technology companies, as well as branches of five Fortune 500 companies. It includes a business incubator, which currently hosts 12 emerging companies, several of which are spin-offs from the university. The Park is an independent legal entity [501(c)3]. We currently are developing a second UA Tech Park, focused on biotechnology, closer to the UA campus, and recently received $4.7 million in ARRA funds from the U.S. Department of Commerce to build the utility and roadway infrastructure that will allow us to develop the property.

Gaps in Our Ability to Provide Necessary Research Infrastructure

All of the innovative collaborations and approaches being used to facilitate leading-edge research require new or upgraded research facilities, for which there is currently insufficient funding. Under current conditions, many of these needs will likely go unmet.

As we seek multiple funding sources and new arrangements to fund building renewal and upgrades, the UA and other universities across the country face a specific and severely hobbling gap in funding opportunities. Donors may be willing to help to fund new buildings, but they are very rarely willing to contribute to ongoing operations, maintenance, or upgrades. For lack of funds, maintenance and upgrading are often deferred or neglected. Allowing our universities' older research buildings to languish raises the future costs of providing the necessary physical research infrastructure. As discussed earlier, the University of Arizona has a growing need for refurbishment of its buildings that exceeds $200 million today.

Beyond a shortage of funds for building renewal, universities face a confounding problem: a gap in funding opportunities for mid-scale instrumentation facilities. NSF's Major Research Equipment and Facilities Construction (MREFC) program supports the acquisition, construction, and commissioning of large scale research facilities and equipment, in the tens to hundreds of millions of dollars range, that uniquely advance the frontiers of science and engineering. Initial planning and design, as well as follow-on operations and maintenance costs of the facilities, are provided. NSF's Major Research Instrumentation (MRI) program funds the acquisition or development of single pieces of research instrumentation, up to $4 million in cost (or $6 million, with ARRA funds), that are to be shared by multiple investigators. The program explicitly does not support acquisition or development of the whole suite of instruments that is often needed to outfit high-end research facilities. Similarly, the NIH has a Shared Instrumentation Grant (SIG) program that supports the purchase of instruments up to $600,000 in cost. The huge gap between these two funding mechanisms and the MREFC makes it very difficult to fund medium-scale infrastructure.

A smaller but still constraining issue arises from the fact that the MRI and SIG programs support the purchase or development of expensive pieces of scientific instrumentation, but do not provide for the renovations that often are needed for installation of the new instruments and do not provide for personnel, ancillary equipment, and upgrades to keep

the instruments at the cutting edge as technology advances. In addition, the MRI program requires universities to provide 30% in matching dollars. Because of the difficulty in finding the funds to fulfill those particular requirements, we are sometimes unable to apply for needed instruments, and even if we do obtain the funds to purchase new items, good instrumentation may fall away from the cutting edge, even when relatively inexpensive upgrades could have kept them up to date.

Recommendations

In light of the severity of the issues I have raised, we recommend the following:

1) *The NSF should increase the percentage of its budget that it spends on infrastructure to 27 percent by FY 2016 -- in accordance with the recommendation made by the National Science Board in its 2003 report, "Science and Engineering Infrastructure for the 21st Century: the Role of the National Science Foundation,"* (http://www.nsf.gov/od/lpa/news/03/pr0340.htm) .

Recent figures suggest that NSF currently devotes some 24 percent of its funding to infrastructure support. As the Congress and the Administration seek to double funding for the agency by FY 2016, we believe the 27 percent target set forth by the National Science Board is a reasonable goal. Moreover, slowly increasing the percentage of funding NSF devotes to infrastructure over 5 years as the overall NSF budget grows should minimize the negative impact on the funds potentially available for research grants and awards.

To help to achieve this goal, we specifically recommend that:

a. *The Congress and NSF should continue to support the Major Research Instrumentation (MRI) and Major Research Equipment and Facilities Construction (MREFC) programs.*

These programs are essential to provide state-of-the-art research equipment priced in the range of several millions of dollars or above tens of millions of dollars. It would be especially helpful for MRI grants in the future (1) to fund not only the purchase of the equipment, but also renovations, ancillary equipment, and personnel that may be needed to put those instruments to best use, and (2) not to require the significant (30%) matching dollars currently required of universities. Absent that additional support, the full costs of providing new technical capabilities are so high that some universities are unable to participate in the MRI program.

b. *The Committee should authorize and funds should be appropriated for the Academic Research Infrastructure (ARI) program to enable NSF to solicit proposals to make additional ARI awards beginning in FY 2012.*

Renovation of existing facilities is a critical need for which it is often difficult to find funding solutions. The inability to modernize existing research facilities often decreases research productivity, meaning that the value of the research funding provided is not fully leveraged, as researchers are forced to conduct their research in suboptimal facilities.

The NSF Academic Research Infrastructure (ARI) program was originally authorized to try to address this very issue. Unfortunately, the program was never very well funded and its last solicitation was in 1996 which is, in part, why the funding provided with ARRA dollars this year for the ARI-R^2 program was received so favorably by the universities I represent here today. The program is right on the mark, aimed at modernizing existing shared research facilities. It will be important in helping to ensure that our research infrastructure keeps pace with our science – that is that the research that NSF funds can be done in appropriate research facilities – but it is funded for one year only, at $200 million. In its single solicitation, it received proposals for $1.02 billion in projects. Extension and expansion of the ARI program, through authorization and funding in FY2012 and beyond, is critical, and the return on this investment will be high. Placing the emphasis on shared facilities ensures maximum impact per dollar.

c. *The NSF should develop a new program to support mid-scale infrastructure projects not currently eligible for support through the MRI and MREFC accounts.*

Such a program would be a significant means to support major research infrastructure needs. The National Science Board (NSB) has identified several specific areas where mid-scale infrastructure is needed. These areas include: acquisition of an incoherent scatter radar to fill critical atmospheric science observational gaps; replacement or upgrade of submersibles; beam line instrumentation for neutron science; and major upgrades of computational capability.

As the 2003 NSB report on scientific and engineering infrastructure noted, *"In many cases the midsize instruments that are needed to advance an important scientific project are research projects in their own right, projects that advance the state-of-the-art or that invent completely new instruments."* Thus, this program would advance the state of research technology, as well as spread the use of such high-end technologies.

2) *OSTP should convene a National Science and Technology working group to assess the effects of the serious decline in state and private funding for university research infrastructure and recommend steps by the federal government to ensure adequate support for the nation's academic research infrastructure.*

The need for such analysis and thought on the financial future of research universities is so dire that, in multiple forums, university leaders across the country already are convening for discussion of, among related topics, specific research infrastructure needs and the most effective solutions that could be implemented. An OSTP working group could incorporate the perspectives of individual agencies and these university discussions to move the national conversation forward with focus, in time for deliberations around the 2012 budget formulation.

Specifically the OSTP working group should:

a. *Assess existing and propose new research instrumentation and infrastructure programs at all federal agencies, including those recommended above for the NSF.*

In recent years, the funds available for research infrastructure programs outside of NSF, such as those supported by the NIH's National Center for Research Resources Division of Research Infrastructure, have dwindled. Meanwhile, the need and demand for these programs remains very high. As just one example, NIST's competitive university facilities construction grant program, which received funding of only $24 million in FY08, was able to support only three out of 93 proposals. Through additional funds provided to this program in FY 09 and through ARRA, NIST has been able to go further to address some of the pent up demand for new research facilities, however, the demand is still very high. Moreover, this demand will only grow as we move to increase the amount invested in research activities at key agencies such as the NSF, Department of Energy Office of Science, and NIST, as called for by the President and in the America COMPETES legislation which this committee will be looking to reauthorize this year.

b. *Conduct a critical review of the increasing financial pressures that impede the ability of research universities and other institutions to adequately support critical physical research infrastructure needs.*

In recent years the amount that universities, including the University of Arizona, have had to spend to ensure compliance with an increasing array of federal regulations has dramatically increased, requiring a significant amount of university revenues to go to supporting a greatly expanded "research compliance infrastructure." Many of these costs are not currently reimbursable by our sponsoring agencies. Thus, they must be paid out of the universities' own institutional funds, draining the resource pool that otherwise is available to help to support the university's physical infrastructure needs. The increasing financial pressure, as well as the impact of increasing cost sharing requirements on universities, should be carefully examined.

Conclusion

The National Academies "Rising Above the Gathering Storm" report had proposed that the government:

> *"Institute a National Coordination Office for Advanced Research Instrumentation and Facilities to manage a fund of $500 million in incremental funds per year over the next 5 years—through reallocation of existing funds or, if necessary, through the investment of new funds—to ensure that universities and government laboratories create and maintain the facilities, instrumentation, and equipment needed for leading-edge scientific discovery and technological development. Universities and national laboratories would compete annually for these funds."*

While we stop short of endorsing the specific amount of funding for infrastructure programs across all government agencies, we feel that there clearly is a need for a revitalization of existing agency infrastructure programs as well as the development of new programs. It is therefore time that the Congress, OSTP, and all federal agencies work together to conduct a serious assessment of what the government can do to ensure that research infrastructure needs required to support government-sponsored research activities are being met adequately.

The significant amount of money devoted to research infrastructure programs in ARRA provided a critical shot in the arm which helped to inoculate the nation against the effects of years of neglect of our research infrastructure. That being said, additional federal support for research infrastructure is still very much needed after ARRA funds end, to carry forward our ability to meet the significant needs that exist for renovation and upgrade of aging facilities across the country. This is particularly true in light of declining alternative funding sources that universities have traditionally been able to rely upon to support their infrastructure needs.

The return on this investment will be high. Our researchers, armed with direct research funding and supported by a strong research infrastructure, will be able to continue to lead the world in innovation and discovery. At my own institution, we have seen what can happen when modern infrastructure is made available: our faculty members almost certainly would not have landed the $50 million grant from the NSF to address major global issues in plant biology if they had not been located in well-outfitted facilities that were designed to enhance cross-disciplinary collaboration.

Thank you for the opportunity to present this testimony.