

# EPSCoR 2030:

## A REPORT TO THE NATIONAL SCIENCE FOUNDATION

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EPSCoR 2030 Workshop  
 WV EPSCoR

*“The voyage of discovery consists not in seeking new landscapes  
but in having new eyes”*

Marcel Proust

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# EXECUTIVE SUMMARY

## EPSCoR 2030 WORKSHOP

JANUARY 19-20, 2012, WASHINGTON, DC

A panel of nationally recognized scientists and engineers met at the behest of the National Science Foundation (NSF) to examine the Experimental Program to Stimulate Competitive Research (EPSCoR) in terms of its relevance to the national research agenda. The two-day workshop produced observations about the value of the NSF program and recommended programmatic changes to be made both by NSF and by the EPSCoR states that can enhance EPSCoR's effectiveness.

- EPSCoR states' universities and colleges and their research faculty play a key role in U.S. economic competitiveness. The future wealth of the nation depends upon Science and Technology (S&T)-based innovation that begins with a well trained "high-tech" work force. S&T enterprises desperately need well-trained professionals at all levels. EPSCoR states are "home" to 57 of the Fortune 500 Companies<sup>1</sup>. When examining U.S. energy production, the importance of EPSCoR states becomes starkly apparent. Ten states produce more energy than they consume; nine of the ten are EPSCoR states<sup>2</sup>. EPSCoR states account for 22 percent of the employed U.S. work force, produce 21 percent of higher education Science and Engineering (S&E) degrees<sup>3</sup>, and confer 16 percent of S&E Ph.Ds<sup>4</sup>. Furthermore, there is capacity to expand these numbers in many of the EPSCoR institutions and states. Consequently, these and other statistics show that EPSCoR states with their research universities and colleges are a huge underutilized resource as the nation tries to keep up with the production of engineers and scientists in China, India and other competitors. Twenty-two percent of high-technology business establishments are located in EPSCoR states<sup>5</sup>. EPSCoR research institutions have a large share of U.S. academic research scientists and engineers and are the S&T centers around which high-tech companies can locate in these states creating opportunities, wealth and quality of life. EPSCoR institutions have educated many of the engineers that support America's major companies.
- The NSF EPSCoR program has been highly successful in building research competitiveness. However, much more needs to be done to secure the program's future success and to tell the "EPSCoR story" of this federal-state partnership and the effects that have been derived from EPSCoR funding in research excellence, promoting science and engineering careers, achieving diversity, and in "spinning off" and assisting S&T-based businesses.
- The vast majority of NSF's S&T investment goes to a small number of non-EPSCoR states and institutions. Eight universities receive more NSF funding than the 31 EPSCoR jurisdictions combined! This disparity demonstrates the national need for continued S&T diversification, workforce development and discovery across the nation as a whole. Yet EPSCoR states, without question, have made great progress in their contribution to the national interest in S&T as a tool for knowledge creation and economic development.
- NSF EPSCoR needs to become more adaptive in order to improve strategic planning and to take advantage of new collaborative research opportunities in areas across states where EPSCoR has built strength relevant to S&T opportunities emerging at the national and international levels.

*The EPSCoR states are a huge underutilized resource as the nation tries to remain competitive internationally and keep pace with the production of engineers and scientists in China, India and other competitors.*

- The 31 EPSCoR jurisdictions in this unique federal-state partnership offer NSF an incredible “test bed” for its new initiatives. EPSCoR institutions and research faculty have experience in S&T areas of national importance including energy, climate change, diversity, defense, scientific computation and homeland security.
- EPSCoR is a unique program at NSF. It is not a research program in and of itself, but a capacity building program that was designed to have an impact on research infrastructure across institutions and states. That is why there is a state committee in every EPSCoR jurisdiction. That is why there is a funding match for the program. That is why there are extensive state-specific S&T plans. This is why in 2006 the EPSCoR 2020 Report recommended that the program be moved to NSF’s Office of Integrative Activities (OIA). The EPSCoR program requires special effort and attention in order to ensure that institutions and states become more competitive. Consequently, EPSCoR cannot be compared with or judged by criteria used in other NSF programs. And, to continue to be successful, it is important that NSF, advisory committees and peer review committees be acutely aware of these special features of EPSCoR.

This report summarizes background, issues, consensus opinions and a series of five major recommendations that grew out of the workshop. Consensus opinions include:

- **Consensus** EPSCoR research universities are a vital resource that can and must be employed as the United States tackles S&T issues impacting the ability of the country to compete in high-tech global markets. Any national research agenda that ignores or diminishes the role of half the states is an agenda that makes a serious omission by excluding highly productive and important components of the nation’s R&D capability.
- **Consensus** There are challenges where EPSCoR institutions have the experience that can help NSF and the nation including energy, climate variation, health, defense and homeland security and cyberinfrastructure.
- **Consensus** While the NSF EPSCoR investment has fueled incredible advancements in building research infrastructure, both NSF and the EPSCoR states need to better articulate the need for and achievements of the NSF (and federal-wide) EPSCoR and IDEA efforts.
- **Consensus** One of EPSCoR’s strengths is that state committees, universities and faculty are committed to scientific and engineering excellence.
- **Consensus** EPSCoR’s current award mechanisms could be modified to better reflect new NSF priorities, reduce the emphasis on funding multiple activities with a single award, focus funding on achieving critical needs in science and infrastructure and allow groups of EPSCoR researchers to better pool the expertise which EPSCoR already has developed in areas like water, energy, and cyberinfrastructure.

**Recommendations include:**

- Since NSF EPSCoR research is critical to the nation’s science and technology policy, NSF must continue to expand its EPSCoR funding and overall support in order to guarantee this program’s relevance.
- NSF EPSCoR should return to its original focus of increasing research capacity.
- NSF should use EPSCoR states and their research institutions as a test bed for new agency initiatives taking advantage of their size, diversity and nimble structures.
- NSF and EPSCoR institutions must act now to develop a robust cyberinfrastructure to ensure that faculties are, and remain, competitive.
- The “EPSCoR success story” must be better told in the national interest.

These major recommendations are broken down into more detailed sub-recommendations, strategies, programmatic and policy actions in the body of this document.

# EPSCoR 2030 WORKSHOP

## BACKGROUND & STRUCTURE

Submitted to the Director of the National Science Foundation  
April 2012

*“I am very grateful to all of you here today, and the President is grateful for your being here to talk about the vital role that EPSCoR plays and will continue to play as this Administration and, we trust for that matter, future generations work to continue to strengthen research and education in science, technology, engineering, and math, what we have come to call the STEM subjects.”*

John Holdren, Office of Science and Technology Policy, The White House

The Experimental Program to Stimulate Competitive Research (EPSCoR) has become the National Science Foundation's most important and visible tool to ensure that all states and regions of the United States fully participate in and benefit from its research and education activities. Virtually every issue confronting the nation's ability to generate a well-trained workforce that can thrive in increasingly competitive global markets requires a high level of science and engineering (S&E) vigor in all states' universities and colleges.

EPSCoR is NSF's only state-based program, and accounts for about two percent of the agency's budget. NSF's 30-year investment in EPSCoR continues to build the level of scientific and engineering capacity and expertise that exists in the 28 states and three territories that are now eligible to receive EPSCoR funding. Researchers at more than 70 universities are funded by NSF EPSCoR, and the investments have greatly strengthened research and education activities in these institutions. Faculty and students at dozens of four-year and community colleges also participate in EPSCoR-funded research activities. This is important to our nation because of the collective size of the EPSCoR higher education “community” which accounts for nearly one-fourth of the U.S. population<sup>6</sup> and produces more than one-fifth of the nation's S&E degrees<sup>3</sup>. Nearly one-fifth of “high-tech” firms are located in EPSCoR states<sup>4</sup>.

Yet, despite the success of the EPSCoR program over three decades, much remains to be done. Collectively, the 28 states and three territories eligible for NSF EPSCoR received only 13 percent of the NSF “research support” budget in Fiscal Year 2011. In contrast, NSF provided 15 percent of its research support budget to just eight universities! Further, EPSCoR institutions and their research faculty are not well represented on NSF's policy making committees. The “voice” of the 31 jurisdictions is generally missing as NSF makes decisions about the future of the agency's science and technology (S&T) funding investment. It is clear that NSF and the EPSCoR states need to make even better collaborative investments with the limited EPSCoR budget in the interest of a more robust national S&T strategy.

*“The collective size of the EPSCoR higher education community accounts for one-fourth of the U.S. population, and produces one-fifth of the nation's S&E degrees.”*

With EPSCoR, NSF has replicated key aspects of the 1862 Morrill Act model that has worked so well for the last 150 years: providing federal support to build state capacity in higher education and research while respecting the authority of each state to design its own approach based upon individual academic strengths among states and state research interests. EPSCoR universities provide access for faculty and students to research opportunities that, in turn, generate new knowledge. EPSCoR universities also apply this new knowledge to serve the needs of their states and the nation.

NSF's EPSCoR program has always evolved as the agency itself has changed. In 2012, NSF is once again examining EPSCoR with respect to the agency's legislative requirement that the distribution of science and engineering resources encompass a broad range of jurisdictions to capture the diversity of talent in the nation. Toward this end, NSF funded a workshop in January 2012 to examine EPSCoR's relevance to the nation's science and technology priorities. This report presents the workshop's findings where a group of national S&T experts from academe, federal agencies, tribal colleges, minority serving institutions, congressional and state legislative offices, non-profits and the private sector looked anew at the EPSCoR mission and operations. Workshop participants focused on recommendations that can best help NSF and its Director bring the full S&T prowess of universities and colleges located in more than half of the states to bear on solving national S&T issues.

**Workshop Planning and Structure** – Under a grant from the Experimental Program to Stimulate Competitive Research (EPSCoR) at the National Science Foundation, the West Virginia Higher Education Policy Commission conducted the NSF EPSCoR 2030 Workshop on January 19-20, 2012 in Washington, DC at the Russell Senate Office Building. Colleagues from the White House, state and federal government, businesses, academic institutions, professional societies, EPSCoR states and other jurisdictions convened to identify key strategic objectives that will help NSF EPSCoR over the next decade or more.

Planning for the EPSCoR 2030 Workshop began in a Spring 2011 meeting between several members of the EPSCoR community and the NSF Director, Dr. Subra Suresh, where there was a discussion about the need for NSF EPSCoR to more effectively support research infrastructure building activities to position EPSCoR institutions and their researchers to be more competitive in emerging NSF programmatic areas and thereby provide greater support to the President's and Congress's vision for a more competitive STEM culture in America. The EPSCoR "community" provided strong support for a meeting that would build on the outcomes of the original EPSCoR 2020 Workshop held in 2006. In subsequent conversations with NSF EPSCoR Office Head, Dr. Henry Blount, and his staff, Dr. Paul Hill from the West Virginia Higher Education Policy Commission was tasked to take the lead in the new NSF EPSCoR 2030 Workshop whose purpose was "to identify and recommend long-term goals, objectives, and strategies that would serve to more effectively elaborate NSF EPSCoR's vision." Like the earlier workshop, the EPSCoR 2030 Workshop would be a "bottom up effort" that drew upon the expertise of EPSCoR administrators and research faculty.

In preparation for the January 2012 Workshop, three confidential surveys were sent to EPSCoR states' university Presidents, Vice Presidents for Research and principal investigators. These surveys sought their views of EPSCoR's relevance and operations. Dr. Hill also led a series of group meetings with senior EPSCoR administrators and key stake holders. The surveys and meetings produced a series of recommendations (Attachment 3) that were made available to Workshop participants prior to their meeting. To facilitate Workshop participant discussions, several nationally recognized researchers who were familiar with NSF EPSCoR and similar programs in other federal agencies were asked to submit their views of the current and future NSF EPSCoR in a series of White Papers (Attachment 4) which also were made available to participants in the pre-Workshop briefing materials.

Dr. Hill and the NSF EPSCoR Office collaboratively developed the agenda (Attachment 1) and Workshop participants (Attachment 2). All of the participants attended the meeting and were asked to comment and approve this document.

# EPSCoR 2030 WORKSHOP

## ISSUES

*“We have seen time and again that diversity is one of our country’s greatest assets: diversity of experience, perspective, ethnicity, gender, geography. You name it. That diversity is what feeds the spectacular array of ideas from innovative people across the United States. And EPSCoR is about keeping this diversity at the heart of our scientific enterprise. It’s about expanding participation in science and technology in order to cultivate the best in American intellect and ingenuity.”*

John Holdren, Office of Science and Technology Policy, The White House

*“The real issue is how to make these programs relevant to the national interests. And, it seems to me that it’s very easy to do because what the [top tier institutions] don’t take into account is that the non-EPSCoR states cannot afford to always carry the EPSCoR states. We have got to be sure that everybody is brought up to a level so they can carry their own weight if the U.S. is going to have success in the 21st century economy. You cannot afford to have a whole bunch of flyover states that cannot sustain themselves.”*

Mary Good, University of Arkansas – Little Rock

The EPSCoR 2030 Workshop, development of this report and subsequent responses by NSF are occurring as the Congress and Administration implement the reauthorization of the America COMPETES Act. This legislation has been and is likely to continue to be the centerpiece of this decade’s bi-partisan congressional effort to support the National Science Foundation. COMPETES aims to ensure that U.S. universities maintain their predominance and play a lead role in U.S. science, technology, engineering and mathematics (STEM) as they train future S&T workforces and as they help generate and support innovative high-tech firms. The COMPETES Act specifically authorizes the EPSCoR program and requires that the budget for NSF EPSCoR grows apace with the agency’s overall budget. The Workshop’s review of NSF EPSCoR also occurred as a congressionally-mandated evaluation of the federal-wide EPSCoR is beginning. This is not by accident. The Workshop heard from Administration and congressional senior leaders that the current environment for all federal science and engineering programs includes tight budget scenarios. The large turnover in congressional and Executive Branch staff over the last five years means that justification for programs like EPSCoR again will be examined. NSF EPSCoR and its state partners must be prepared to explain what the program has accomplished and how it will maintain its robustness in the future.

*“Speaking from a State legislator’s perspective, I believe one of the very strong impacts that EPSCoR has had in Idaho is that the involvement of the National Science Foundation, the emphasis upon quality of science has resulted in an upgrading of standards across all of the higher education scientific system. That has meant that the State funds which flow into those areas are spent more wisely.”*

Laird Noh, Idaho State Senate

Fortunately, EPSCoR is structured to meet the challenges of the COMPETES Act and the current environment in Washington. EPSCoR is a state-federal-academic partnership involving planning at the highest levels of state government and academe ensuring that all NSF EPSCoR proposals are relevant to state science and economic priorities while meeting national needs. All EPSCoR funding is awarded through merit review, ensuring that all EPSCoR awards meet NSF standards of excellence. Accountability is extremely high; all faculty funded by EPSCoR must seek permanent non-EPSCoR research support from NSF, other federal agencies or from non-federal sources. EPSCoR requires a substantial and real “state match” – 20 percent – for its largest awards, and requires that every EPSCoR jurisdiction have a state oversight body (i.e., the State EPSCoR Committee) whose membership includes representation from state government and business as well as from academe to assure that EPSCoR proposals are compatible with states’ S&T Strategic Plans. Over time, EPSCoR states have developed unique expertise in dealing with state specific issues in energy, rural health, defense and homeland security, cyberinfrastructure, the environment, nanotechnology, computational science, economic diversification and development.

Workshop participants agree that this work builds on and complements the work of the EPSCoR 2020 Workshop held in 2006 and reflects the positive ability of NSF EPSCoR to adapt to a changing environment. There was consensus on several general issues which, taken together, provide an overall context for their recommendations. These include:

EPSCoR research universities are a vital resource that can and must be employed as the country tackles S&T issues impacting the ability of the United States to compete in high-tech global markets. This resource must be fully developed and employed in national S&T-related efforts. Top-tier states and research institutions cannot by themselves meet the higher education S&T training needs of the nation, and state economies and their technological needs cannot be advanced by reliance on the relatively small number of top-tier institutions.

### **Kentucky SBIR**

*There is a disparity in the distribution of SBIR dollars among states. This is important because geographically, more SBIR dollars are spent around research universities than elsewhere throughout the nation. This fact shows that those research universities are developing innovation, and subsequently are sending it out into the local and national economies. This is why SBIR awards are important, and why all regions and states need to successfully compete for these awards. “The University of Kentucky (UK) used to not get any SBIR awards. Now, UK has gotten 54 SBIR’s which have resulted in 23 University of Kentucky spin-out companies in the last five years. There are 89 early stage companies in the Lexington area. They brought in \$65 million worth of investment capital in 2011 and 748 employees (537 of these are employed full-time). The average salary is \$65,500. Product revenue is \$94 million.*

Lee Todd, University of Kentucky

*“EPSCoR has made a difference in our university in the U.S. Virgin Islands. We have, as a result of having the EPSCoR program, developed particular expertise in areas of marine science, and we have faculty there that we never expected to have. We’ve had publications. We have graduate programs that we did not have before. It has made a difference in the Territory’s marine resources management program by helping in developing policies, rules and, regulations.”*

Henry Smith, University of the Virgin Islands

There are challenges where EPSCoR institutions have the experience that can help NSF and the nation. For example, NSF Director Suresh challenged the workshop to provide guidance and best practices information to help NSF increase the numbers of under-represented groups that seek science and engineering careers (STEM degrees). The workshop participants all agree that in this area, the EPSCoR states are doing well and can offer insights to NSF. EPSCoR institutions have become proficient at including women and other underrepresented groups in research infrastructure activities. EPSCoR funding has created programs which have increased the numbers of men and women from Native American, Native Hawaiian, African-American, and Latino-American communities. EPSCoR has created new mentoring efforts that target S&E majors who are "first generation" college students.

While the NSF EPSCoR investment has fueled incredible advancements in building research infrastructure, both NSF and the EPSCoR states need to better articulate the need for and achievements of the NSF (and federal-wide) EPSCoR and IDeA effort. This is essential if adequate resources are to be secured to help EPSCoR institutions and their research faculty become competitive for the challenges of the 21st Century.

*"I think that any of us who have spent time in China or India understand in a very fundamental way - that was articulated wonderfully in "Rising Above the Gathering Storm," - what the nature of international competition is going to be in the future and the fact that the United States, as it currently stands, is not adequately prepared to compete as well as it once did."*

David Dooley, University of Rhode Island



One of EPSCoR's strengths is that state committees, universities and faculty are committed to scientific and engineering excellence. NSF and the states should continue to insist that only meritorious research is funded by EPSCoR. However, EPSCoR states are unique, and their EPSCoR proposals address a wide range of research efforts that are relevant to their faculty and citizenry. Because defining research excellence involves a thorough understanding of both science and circumstance, the EPSCoR review process should evaluate research excellence in the context of the needs and infrastructure of the state.

*"We are trying to meet Maine's needs doing quality research, but there are so many other demands on it that half of the proposal doesn't have anything to do with the science."*

Michael Eckardt, University of Maine



EPSCoR's current award mechanisms could be modified to better reflect new NSF priorities, reduce the emphasis on funding multiple activities with a single award, focus funding on achieving critical needs in science and infrastructure and allow groups of EPSCoR researchers to better pool the expertise which EPSCoR already has developed in areas like water, energy, and cyberinfrastructure. NSF's non-EPSCoR program managers must look for opportunities to target the research strengths of EPSCoR states in new NSF initiatives and by taking full advantage of the co-funding mechanisms of EPSCoR. All NSF directorates and officers need to play a stronger role in ensuring that the basic mission of EPSCoR is successfully accomplished.

# EPSCoR 2030 WORKSHOP

## RECOMMENDATIONS

**Recommendation 1. Because research funded by the NSF EPSCoR program is integral to the nation’s science and technology (S&T) policy, NSF must continue and expand its funding and overall support for this program in order to guarantee its relevance.**

*“Let me say right off the bat that the EPSCoR program is critically important and it is important not just because of its basic function of bolstering research and supporting graduate education across the nation but also because of the values it represents”*

John Holdren, Office of Science and Technology Policy, The White House

The Head of the Office of Science and Technology Policy, Dr. John Holdren, and the Director of the National Science Foundation, Dr. Subra Suresh, both recognized the importance of EPSCoR, and the role that EPSCoR universities and colleges and their research faculty play in educating the nation’s S&T workforce. NSF EPSCoR has been highly successful as indicated by both the impact upon states’ general competitiveness and by the illustrative examples of achievements that have been derived from EPSCoR-funded research.

*“...in the last 5 years, 23 of 27 EPSCoR jurisdictions for which we have data received an increasing proportion of the non-EPSCoR total NSF research funding. That’s an important metric to keep. I think that this is one of the metrics of success in the future.”*

Subra Suresh, National Science Foundation

Over the last decade, most if not all of the growth in the NSF EPSCoR budget has been used to accommodate funding requests from newly EPSCoR-eligible states. The fact that there are now 31 jurisdictions that are EPSCoR eligible could be due to the dramatic increase in NSF funding under the American Recovery and Reinvestment Act of 2009 and the geographic distribution of those funds. NSF should take the lead in ensuring that real coordination exists in EPSCoR/IDeA programs at all six federal agencies. Coordination could greatly enhance the statewide efforts for S&T coordination.

- 1.a** In order to achieve its congressional mandate, NSF must make EPSCoR a priority with a robust program – its only state-based program – to advance the mandate of avoiding “undue concentration” of resources as stated in the organic NSF legislation. All NSF research programs should be more sensitive to this geographical requirement directed at underserved states.
- 1.b** As the lead agency (the NSF EPSCoR Office Head serves as the Chair of the Federal EPSCoR Interagency Coordinating Committee), NSF should work with the federal managers of the other EPSCoR/IDeA programs to ensure that federal-wide EPSCoR/IDeA efforts are effectively coordinated, that management “best practices” are shared.
- 1.c** All activities funded by NSF EPSCoR should continue to meet the requisite criteria, established by the National Science Board, for intellectual merit and broader impacts.

## Recommendation 2. NSF EPSCoR should return to its original focus.

*“...it seems to me the program is beginning to lose the focus for which it was designed. It was designed to make these states and the research universities in these states competitive with the national research agenda. And, now we have gotten a program that is extremely bureaucratic. It has all kinds of hoops that you have to jump through. And about half the money goes to non-research activities. And, to me that is losing sight of what the program was designed to do.”*

Mary Good, University of Arkansas

In 1979, EPSCoR was established to help research universities and faculty in states that had historically not benefitted from NSF-funded research activities to better compete for NSF and other federal S&T competitions. Over time, the programmatic mechanisms that were used in 1979 have been modified as needed. The 2030 Workshop participants feel that it is time to once again review all of the current requirements for a successful EPSCoR RII Track I proposal and modify them as appropriate with input from the EPSCoR senior administrators at EPSCoR research institutions.

New EPSCoR grant requirements have diluted EPSCoR’s focus and effectiveness over the last few years through the addition of a series of grant requirements that reduce the amount of funding available for science and engineering research. From an institutional perspective, the potential power of a \$20 million EPSCoR research grant is weakened quickly by these new requirements and by distribution of grant dollars among several institutions in the state. The administrative and reporting requirements of these awards continue to grow and create an additional burden that takes time and funds away from the scientific efforts. There needs to be more distinction between EPSCoR awards that fund S&E research infrastructure activities, EPSCoR awards that fund S&E “pipeline” infrastructure activities, co-funding and outreach infrastructure. EPSCoR also needs a new “Acceleration” award mechanism to take advantage of new collaborative opportunities. NSF EPSCoR should consider reconstructing its EPSCoR award mechanisms into four categories as follows:

- 2.a** There is strong consensus that the Research Infrastructure Improvement (RII) Track I awards should remain the centerpiece of NSF EPSCoR. The 2006 change in amount (up to \$4 million per year) and duration of these awards (up to 5 years) is optimum at this time. However, the Track I awards should be reconfigured to fund only science and engineering research activities. This should continue to be flexible and include faculty recruitment and development, both graduate and undergraduate student mentoring, traineeships for doctoral students and essential research infrastructure including instrumentation, core facilities and cyberinfrastructure.
- 2.b** NSF EPSCoR should use RII Track II awards to fund statewide activities to strengthen the S&T pipeline including outreach, workforce development, K-12 programs, etc. These activities previously had been funded under Track I awards, but the Workshop participants feel that by separating “pipeline” activities into their own awards, states can do a much better job of bringing the requisite expertise to bear on these issues. This would move away from the current “one-size-fits-all” approach and also allow states to focus on pipeline problems that are germane to their states and institutions. The Workshop participants who were familiar with NIH’s EPSCoR-like program, the Institutional Development (IDeA) Awards, strongly believe that NIH has had great success by utilizing a biomedical research funding mechanism focused on the “pipeline” and attracting more students to biomedical careers.

*“One of the very important things that the EPSCoR program has done is innovative co-funding, and that’s a very strong leveraging program.”*

Jerry Odom, University of South Carolina Foundations

- 2.c** The EPSCoR co-funding initiative is viewed as highly successful and should be continued in its current format. This program allows NSF program managers to make additional grants to EPSCoR researchers. Several thousand researchers have benefitted from this EPSCoR mechanism. As international connections and collaborations become more important, EPSCoR should consider using co-funding monies to facilitate these connections.
- 2.d** EPSCoR Outreach has been highly successful at bringing permanent NSF program officers to EPSCoR institutions. This effort has been a significant benefit to faculty in EPSCoR states, especially those at the Assistant Professor level. As NSF develops new initiatives, and as groups of EPSCoR researchers develop collective “critical mass” strength, better use of Outreach Workshops (perhaps at NSF) may be to bring EPSCoR and non-EPSCoR researchers and NSF program officers together to discuss new programs and best practices and to develop new collaborations. It would be a relatively easy change to make. Outreach funds also should be increasingly used to document the “best practices” that have occurred in a number of areas as a result of EPSCoR funding. For example, information about the successful EPSCoR efforts to increase the number of students from underrepresented groups enrolling in and completing STEM discipline degree programs is of high relevance to the NSF Director.

*“The five-year EPSCoR grants (RIIs-Track 1) are terrific for developing infrastructure, but there remains a critical gap between this and the readiness to successfully compete for the Science and Technology or Engineering Centers. Five-year grants allow institutions to hire junior and senior people and provide the facilities and start-up packages that enable them to establish programs like Montana State’s optics, but they are not designed to facilitate the next step; transformative, creative interdisciplinary research. It would be fantastic for EPSCoR to develop a bridge program that would fund the creative science and engineering research and graduate training that would maximize the transformative potential of the previous EPSCoR investments in the state’s research and engineering enterprise. I envision something like the new Engineering Frontiers in Research Program, a four-year, \$2 million grant to sponsor truly creative and transformative ideas.”*

Kathie Olsen, Science Works

As the S&T environment in the U.S. continues to change rapidly, the NSF EPSCoR program needs to develop funding mechanisms that can quickly take advantage of new collaborative research opportunities. EPSCoR has helped institutions develop strengths and expertise in many important science and engineering areas. The program needs funding mechanisms to promote collaboration among S&E groups in these areas.

*“We also look forward to bringing forward opportunities and initiatives that really activate more multi-jurisdictional collaborations.”*

Denise Barnes, NSF EPSCoR

- 2.e** NSF EPSCoR should consider using a new funding mechanism, referred to as “Acceleration Awards” at the 2030 Workshop, that would facilitate multi-jurisdictional collaborations among scientists who have received NSF EPSCoR support. These awards would allow researchers to coalesce their individual expertise into a “critical mass” to prepare them to compete for large scale NSF or other agency competitions. Essentially, these Acceleration Awards would be similar to mini-ERCs or STC’s, ultimately leading to proposals being submitted to these competitions. These awards should specifically provide for support of graduate students and post docs.
- 2.f** Regarding the merit review process of EPSCoR proposals, two items surfaced. Participants at the 2030 Workshop suggested that as part of any RII Track I review, a site visit (or at a minimum, a reverse site visit) should occur to ensure that reviewers have the chance to make more informed decisions about the scientific merit of the proposed research, the scholarly credentials of the personnel who will be engaged in the proposal, to understand state S&T needs and the justifications for the specific approach. Another significant concern was the long delay in informing states that did not successfully compete in Track I competitions. This long and unnecessary delay leaves these states with insufficient time to prepare for the next competition. As soon as the NSF EPSCoR Office has decided to decline a Track I, the PI should be informed.
- 2.g** As NSF EPSCoR returns to its original focus it might consider renaming the RII’s to better reflect their purpose, perhaps using a title like Building Research and Innovation Capacity (BRIC) awards.

**Recommendation 3. NSF should use EPSCoR states and their research institutions as a test bed for new agency initiatives.**

*“In the previous workshop, as in this workshop, there was a recommendation that the EPSCoR states, because they were so different and because they combine half the nation, might serve as a “test bed” for new and innovative programs. When we look at our states with the HBCUs and the tribal colleges and so forth, you have an excellent platform as a test bed. So if you Dr. Suresh comes up with something to use agency-wide in terms of increasing females and increasing underrepresented minorities, I ask that you perhaps think about using us as a test bed to see how that idea works.”*

Jerry Odom, University of South Carolina Foundations

*“So, in terms of this experiment, I think we can truly be an experimental test bed for doing these kinds of things and making the connections. Because we are really different, we are small. We tend to be much more intimate. We really ought to be doing some pretty bold experiments here because we might be able to make some serious advances because of how we work, nimbleness we have as opposed to the really massive states. It’s changing the meaning of experimental in a different way. We can now almost reverse it and be the Wal-Mart for the Nation that doesn’t exist in other places.”*

Kelvin Droegemeier, National Science Board

Several of the EPSCoR 2030 Workshop Panel participants also participated in the 2020 Workshop held in 2006. They pointed out that this suggestion was one of the key recommendations from the 2006 meeting. The EPSCoR 2030 participants suggested that NSF should again consider using its EPSCoR effort as a test bed for the NSF's new initiatives. For example, EPSCoR universities are already successfully collaborating at the intra- and inter-university levels. The NSF Director expressed his concern about the agency's failure to adequately diversify the nation's S&T pipeline. It was noted that EPSCoR states have developed expertise in bringing together their majority-serving institutions, tribal colleges and Historically Black Colleges and Universities (HBCUs) to improve the research experience/training of those institutions serving large underrepresented minorities. Similarly, EPSCoR universities have expertise in broad areas of national importance including: building cyberinfrastructure among disparate universities; biomedical research addressing rural populations and health disparity issues; climate change and its impact on rural and urban populations; homeland security issues including border and transportation issues; and national energy issues including fossil as well as alternative energy resources. Regarding the last item, it is worth noting that eight of the nation's ten largest net energy exporting jurisdictions are EPSCoR states.

*“The issues that have resonated with our congressional members have been national security, energy security and contributions to this work. If you looked at New Hampshire’s last EPSCoR initiative, the largest flow physics facility in the world, it’s not creating jobs but providing a test bed for aeronautics and submarines, and that also seems to be the message. So, yes, it’s about our state, about our region, but, we’re also making major contributions in areas of energy security, national security, and I think we need to highlight those.”*

Jan Nisbet, University of New Hampshire

As in 2006, the 2012 Workshop suggested that NSF's non-EPSCoR program managers should be asked to play more of a key role in determining how EPSCoR states could be used as a test bed for new programs, and how EPSCoR researchers can be fully integrated into these new programs. The participants also suggested that it is crucial to the national goal of ensuring full participation in NSF-funded activities that NSF's Advisory and Review committees be geographically diverse. The participants believe that a first step toward achieving this goal could be met as part of an effort to involve NSF's senior program managers as described above.

- 3.a** NSF senior management and the States' EPSCoR Program Directors should consider developing an iterative process for identifying emerging NSF initiatives with the S&T expertise that has been developed through EPSCoR-funded research investments over the last decade for the purpose of developing potential test beds for new agency ideas.

*“We can identify topics where we have very clear contributions to make, areas of excellence. Create the workshops again, and make them a benefit for all of NSF, not just for EPSCoR. It allows us to message what we’re doing well, and it allows us to bring to the table the high quality approach that is of interest broadly.”*

Judith Van Houten, University of Vermont

NSF EPSCoR can use existing programmatic tools including workshops and small planning grants to bring groups of researchers together to develop and propose experimental approaches to problems.

- 3.b** NSF should build collaborations between EPSCoR and the Science of Science and Innovation Policy (SciSIP) program to promote better understanding and use of models, tools, data, and metrics that drive science and research policy at the state and national levels. As states assume more responsibility for S&T policy, state leaders (governors, legislators, university administrators, business leaders) need the technical expertise necessary to make informed policy decisions. At the same time, funding for research and higher education is declining, and governments will need to be more strategic about their investments in these areas. Examples of joint EPSCoR/SciSIP projects could be to identify more efficient ways to organize research operations, measure the return on investment in research and communicate the benefits of research to different audiences. The empowerment of all states as partners with the federal government in this important work will lead to greater innovation and competitiveness for the nation as a whole.
- 3.c** The lack of representation from EPSCoR jurisdictions on NSF Advisory Committees needs to be addressed since it compounds the disconnect between agency planning and more than half of states. Participation on these Committees provides participants and their institutions with insights about the directions NSF Directorates and programs are moving. At the time of the EPSCoR 2030 Workshop, eleven EPSCoR states have no representation on NSF Advisory Committees, and only one state is represented on as many as three committees. Among non-EPSCoR states, only two states have representation on less than three committees.
- 3.d** The NSF EPSCoR Office should work with EPSCoR jurisdictions to compile a list of nationally recognized EPSCoR researchers who are willing to volunteer for service on the agency’s Advisory Committees. The NSF Director’s Office should ensure that this list is available and utilized as Committees are periodically reconstituted.

**Recommendation 4. NSF and EPSCoR institutions must act now to develop a robust cyberinfrastructure to ensure that their faculties are competitive.**

*“I think the states need a strategic plan for cyberinfrastructure because it is the most enabling piece of infrastructure that supports all kinds of science. Every science is enabled by cyberinfrastructure”*

Gwen Jacobs, Montana State University/University of Hawaii

**Wyoming Super Computing Center**

*“Wyoming has now become home for the National Center for Atmospheric Research at the Wyoming Super Computing Center. This just completed facility has already changed the research landscape in the state. Its placement in Wyoming is the result of three separate organizations doing critical planning: The Wyoming Business Council, which is essentially the state’s Department of Commerce; Cheyenne LEADS, a local developer who provided land and identified the availability of a surplus of optic fiber and cheap power that could attract cyber companies; and the University of Wyoming, (UW) which over the last 15 years has hired 30 computational scientists. With the help of EPSCoR, these UW scientists have developed a solid expertise in how oil, gas, and water flow in sandstone and limestone reservoirs. The NSF award for the facility totals \$54 million. Over the next 20 years, Wyoming will contribute a total of \$40 million toward this project (perhaps the largest state investment in an NSF award). This project will both advance science and have an important economic impact upon the Wyoming economy. Finally, Wyoming voluntarily elected to share this facility with its EPSCoR colleagues, hoping to generate new collaborations among established and potential atmospheric and geosciences researchers.”*

Bill Gern, University of Wyoming

The cyberinfrastructure landscape has changed so rapidly that even the top-tier states and institutions are having a hard time staying on top of community standards in networking, computational platforms, collaboration environments, identity management and security, and keeping up with new software architectures, etc. Even for institutions that have invested heavily in this area, it continues to be a steep learning and price curve. EPSCoR has led the way in several areas of the nation with significant cyberinfrastructure now penetrating the Northern Tier of states (from North Dakota through Montana, and Idaho to Washington), the Northeast (Vermont, Maine, New Hampshire, Rhode Island and Delaware) and Louisiana. Yet work remains with many EPSCoR institutions needing basic core cyberinfrastructure.

Without strategic action, EPSCoR states stand to lose their investments in intellectual capital and research capacity, as the “best and brightest” scientists are recruited by institutions that are making cyberinfrastructure investments that can support their research. The workshop participants suggested that NSF EPSCoR and the states: (1) develop strategic plans for investing and implementing cyberinfrastructure development at the institutional, system and statewide levels; and (2) NSF develop flexible EPSCoR funding models allowing EPSCoR states to reach their cyberinfrastructure goals and maintain their research competitiveness nationwide. These investments can then be sustained through institutional investments and as part of the Track 1 RII awards. [Note: this recommendation could be accommodated within a new “Acceleration” Award mechanism as described in Recommendation 2.e above.]

Professional cyberinfrastructure staff is an essential component for operating modern cyberinfrastructure facilities on a long-term basis. Not only does this free faculty from conducting basic operating procedures, it provides for the maintenance of on-going upgrades that only professional staff could possibly maintain. The body of knowledge necessary is simply beyond the small number of cyberinfrastructure savvy faculty who work to bring infrastructure to the campus. And even if they were to do this task, it leaves little time to actually do their research. Without this flexible funding, EPSCoR states will not be able to close the “cyber gap” with other states. The gap exists in large part because the costs of developing cyberinfrastructure tend to be significantly higher in EPSCoR states because of distances from available broadband connections. EPSCoR researchers are experiencing difficulty in competing for large NSF cyber-related awards and computational science because of a lack of access to the TeraGrid (now XSEDE) or a local or regional computational resource. Without this NSF investment, EPSCoR researchers will be at a disadvantage when competing for future large-scale federal awards requiring well-developed cyberinfrastructure. This disadvantage also will impact EPSCoR institutions’ ability to attract competitive faculty, inhibit collaborations with other states’ competitive faculty, and discourage the location of high-tech companies that require access to competitive faculty who conduct computational research.

*“.you have to focus more on collaborations. Science is very collaborative.”*

Ann Zulkosky, Senate Staff

This is an area where EPSCoR states have the opportunity to work together. It is an expensive proposition to set up a data center in any state. EPSCoR states have an excellent opportunity to form regional resource collaboratives to jointly support the cyberinfrastructure needs of their states.

- 4.a** NSF EPSCoR should consider working with the states to develop strategic plans for cyberinfrastructure at the institutional and state levels. The plans would need the endorsements of senior university research administrators, chief information officers and members of regional high speed network consortia. An excellent model can be found in Wyoming with the National Center for Atmospheric Research-Wyoming Super Computing Center and its strategic planning, and these entities are very willing to assist other EPSCoR jurisdictions as they plan initiatives for their respective states.

- 4.b** NSF EPSCoR and the states could use the Acceleration award mechanism described above to bring this opportunity for a multi-jurisdictional collaboration to fruition.

**Recommendation 5. The “EPSCoR Success Story” needs to be told.**

Dr. Holdren and Dr. Suresh and the Congressional staff each stated that there is a strong need for more information about the impact of NSF-funded research upon science and engineering disciplines and upon societal issues. Congressional staff also made this point with regard to EPSCoR. This is especially important in the expected tight budget environment that all federal programs will face in the next few years.

*“A lot of the questions that we’re talking about, budget policy, the most efficacious ways to organize research, State-Federal partnerships, everything from dissertation research to multi-state collaborative research could be disseminated across the country through some kind of science colloquium approach.”*

Jay Cole, West Virginia University

*“Until recently, many National Science Board Members had never heard of EPSCoR.”*

Kelvin Drogenmeier, National Science Board

The need to better communicate EPSCoR success is also true within NSF. Although avoiding undue geographic concentration of the federal R&D enterprise is part of the NSF authorizing statute and EPSCoR is the only program directed at this statutory mandate, many constituents are unaware of its important mission and contribution to the national research enterprise. Past efforts need to be repeated and improved as there has been a great turnover in the congressional committee membership that controls federal S&T resources. In telling the EPSCoR story, the states need to move beyond merely showing how many additional proposals were funded, how many additional research dollars were garnered, or how many research papers were published because of EPSCoR. Those things are important, but with regards to economics, they are not especially important to the public or lawmakers. The “impact” of these things needs to be told.

*“...one of the great things about EPSCoR jurisdictions is, more so than some of your other peers, you all are hooked into the business community, the local government in a way that a lot of scientific institutions aren’t. You’ve made the case in your jurisdictions, but it’s time to renew that among members of Congress.”*

Jean Toal Eisen, Congressional Staff

This also is true at the state level. The problem is complicated by the fact that there is not agreement among NSF EPSCoR and other agencies with EPSCoR-like programs regarding measures of success. Vast amounts of statistical and qualitative information are being collected from states and institutions about EPSCoR’s performance, but there is a dearth of information from the agencies about how these data are used. This is a lost opportunity to tell the success story of EPSCoR. It is clear from statements by congressional staff that the information being provided to NSF (and other agencies) is not being distilled into a coherent story and provided to Congress.

The Workshop participants believe that both quantitative and qualitative information is needed to evaluate EPSCoR's worth. EPSCoR states have learned a great deal about the "best practices" of building research infrastructure, promoting diversity, supporting innovation in rural communities and building technology-based economies. This information needs to be combined with statistics and "packaged" for various audiences including: both the House and the Senate at the national level; state legislators; the private sector including both for-profit and not-for-profit companies and organizations; and the press. NSF's own Science and Engineering Indicators and EPSCoR Office data should be mined for the data needed to contribute to this effort.

*"We need to go back and figure out what types of investments with EPSCoR caused us to build certain programs at our institutions and how that may have benefitted economic development in our community and in our state. A classic one for Montana is that from the period '93 to '98, we made a strategic investment using EPSCoR dollars to build our optical technology center at our institution, Montana State University. As a result of that, we have had a huge number of new startups in the optical sciences area to a point where we went from two companies in 1990 to 34 as of last month, and those are in Bozeman and Gallatin county. Tucson, Arizona is the optics capital of the nation. On a per capita basis, we have more than twice as many optics companies as Tucson."*

Thomas McCoy, Montana State University

*"...if you look across the breadth of EPSCoR states, you'll find pockets of real capability to "move the needle," Native Americans in Wyoming, South Dakota, Oklahoma, and Montana. If you look at states like Rhode Island and many other EPSCoR states, you have real urban problems and all the diversity and opportunity problems that reside there. You could build a coalition of those institutions inside EPSCoR to come forward and say that we're going to cooperatively work together to move the needle significantly, measurably in those areas...the advantage that we have is that we're thinking as a community, and that positions us a little bit more strongly than others to come forward with these kinds of innovative ideas."*

Jean Toal Eisen, Congressional Staff

- 5.a** As the lead agency for the federal-wide EPSCoR effort, NSF should work with the other EPSCoR agencies to develop broad criteria for measuring the success of the program. Each agency also should indicate any additional agency-specific criteria. These criteria should be provided to Congress, EPSCoR State Committees, State Project Directors, Review Panels, etc.
- 5.b** Each EPSCoR state should generate state reports describing the EPSCoR impact at the national, state, institutional, and disciplinary levels. The reports should focus on areas of achievement and best practices that are in areas of special current importance. Currently, several states produce this type of information. For example, the University of Wyoming produces an economic index report related to the state's S&T interests (relying heavily on the NSF Science and Engineering Indicators publication) and West Virginia publishes its annual report for public distribution. The need for this information is especially true for programs like EPSCoR. The dearth of information about EPSCoR-funded research ultimately reflects negatively on both the agencies and the states. General guidance about what types of information and method of presentation should be provided by NSF EPSCoR.

- 5.c** The Workshop participants suggested that NSF EPSCoR once again sponsor analyses of specific EPSCoR impacts. Several of the EPSCoR states have this capability/expertise and could be contracted to produce reports for each of the states. As a first step, NSF EPSCoR should make the large amount of data that has been collected from EPSCoR states and the successes of the EPSCoR program publically available.
- 5.d** NSF should take the lead to ensure that data collection is coordinated with information being collected by other EPSCoR programs, and that the data is compatible with information produced in the Science and Engineering Indicators publication which NSF prepares for the nation.

## Sources

<sup>1</sup> <http://money.cnn.com/magazines/fortune/fortune500/2011/index.html>

<sup>2</sup> US Energy Information Administration - State Energy Data 2009: Table C10

<sup>3</sup> Science and Engineering Indicators 2012, National Science Board, Chapter 8, table 8-38

<sup>4</sup> Science and Engineering Indicators 2012, National Science Board, Chapter 8, table 8-19

<sup>5</sup> Science and Engineering Indicators 2012, National Science board, Chapter 8, table 8-52

<sup>6</sup> <http://exploredia.com/population-of-us-states-2011/>



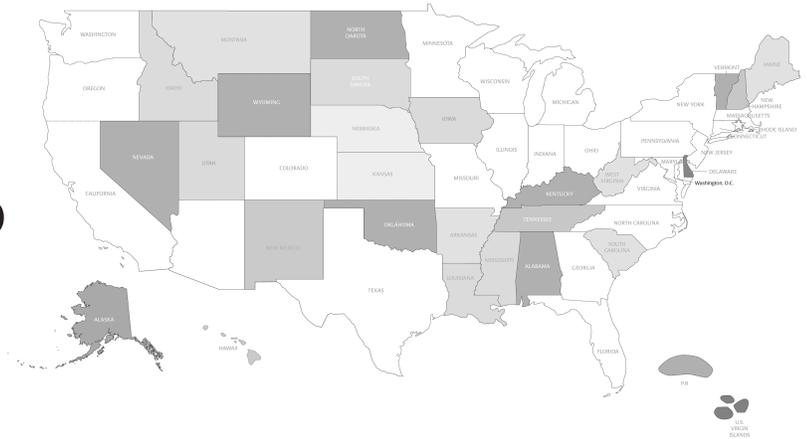
# EPSCOR 2030:

## ATTACHMENTS

APRIL 2012

# ATTACHMENT 1 EPSCOR 2030 WORKSHOP

## AGENDA



Commerce, Science and Transportation  
Committee Hearing Room  
Russell Building Room 253 | Washington, D.C.

### Thursday, January 19, 2012

**Day 1 – Focus:** Review of Program, Issues, Pre-Workshop Meetings and Discussions with EPSCoR “community” of Presidents, Senior Administrators, and State Project Directors

**1:00 – 1:15 p.m. Introduction and Welcome:**

Dr. Paul Hill

*Vice Chancellor for Science and Research, West Virginia Higher Education Policy Commission and Executive Director, West Virginia Experimental Program to Stimulate Competitive Research.*

**1:15 – 1:30 p.m. Perspectives from The Office of Science and Technology Policy (OSTP)**

The Honorable Dr. John Holdren

*Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology (PCAST).*

**1:30 – 1:45 p.m. Perspectives from National Science Foundation (NSF)**

The Honorable Dr. Subra Suresh

*Director, National Science Foundation.*

**1:45 – 2:00 p.m. Perspectives from the U. S. Senate**

The Honorable John D. Rockefeller

*U.S. Senator (D-WV); or,*

*Ann Zulkosky*

*Senior Professional Staff, U.S. Senate Commerce, Science, and Transportation Committee.*

- 2:00 – 2:15 p.m. Overview of NSF EPSCoR Objectives, Program Mechanisms, and Budget**  
 Dr. Denise Barnes  
*Acting Head, Office of Integrative Activities*  
*Experimental Program to Stimulate Competitive Research, National Science Foundation.*
- 2:15 – 2:20 p.m. Overview of Pre-Workshop Surveys and Discussions—  
 Setting the context from institutional, managerial and  
 faculty perspectives.**  
 Dr. Paul Hill
- 2:20 – 2:45 p.m. Panel Reactions & Strategic Perspectives**  
 John Riordan
- How can we best capture and communicate quantitative and qualitative data regarding the impact of the EPSCoR Program?
- 2:45 – 3:00 p.m. BREAK**
- 3:00 – 5: 00 p.m. Roundtable Discussion of White Papers**  
 Moderator: John Riordan
- Opening Remarks** (5 min each):  
 Selected Whitepaper—Strategic Opportunities and Cyber Tools  
 Selected Whitepaper—Power in Planning  
 Selected Whitepaper—Ensuring Excellence for our Nation
- Open Discussion among Participants:**  
 Where does EPSCoR need to go in the future? What are the strategic priorities we need to focus on?
- 5:30 – 7:30 p.m. Networking Discussions**

## Friday, January 20, 2012

- Day 2 – Focus:** Formulation of Recommendations to NSF
- 9:00 – 11:30 a.m. Roundtable Discussion of Issues Confronting NSF EPSCoR  
 and Panel’s Recommendations to NSF**
- Using the draft list of Recommendations, the Panel will provide input to refine recommendations and potential implementation steps.
- 11:30 – 1:00 p.m. Summary and Concluding Remarks  
 Working Lunch**

# ATTACHMENT 2

## EPSCOR 2030 WORKSHOP

### PARTICIPANTS

Dr. Peter Magrath	Binghamton University
Dr. Laird Noh	Idaho EPSCoR
Dr. Kerry Davidson	Louisiana Board of Regents
Dr. Sandra Harpole	Mississippi State University
Dr. Thomas McCoy	Montana State University
Dr. Denise Barnes	National Science Foundation
Dr. Cliff Gabriel	National Science Foundation
Dr. Subra Suresh	National Science Foundation
Dr. John Holdren	Office of Science and Technology Policy
Dr. Thomas Shortbull	Oglala Lakota College
Dr. Kathy Olsen	ScienceWorks, LLC
Dr. Mark Myers	University of Alaska-Fairbanks
Dr. Mary Good	University of Arkansas at Little Rock
Dr. Gwen Jacobs	University of Hawaii System
Dr. Lee Todd	University of Kentucky
Dr. Michael Eckardt	University of Maine
Dr. Rita Colwell	University of Maryland
Dr. Jan Nisbet	University of New Hampshire
Dr. Kelvin Droegemeier	University of Oklahoma
Dr. David Dooley	University of Rhode Island
Dr. Jerome Odom	University of South Carolina
Dr. Laura Jensi	University of South Dakota
Dr. Henry Smith	University of the Virgin Islands
Dr. Judith Van Houten	University of Vermont
Dr. William Gern	University of Wyoming
Ann Zulkosky	US Commerce, Science and Transportation Committee
Jean Toal Eisen	US Senate Appropriations Committee
Dr. Tamara Goetz	Utah Governor's Office of Economic Development
Dr. Paul Hill	West Virginia Higher Education Policy Commisison
Dr. Jay Cole	West Virginia University
John Riordan	Faciltator

# ATTACHMENT 3

## EPSCoR 2030 WORKSHOP

### PRE-WORKSHOP SURVEY RECOMMENDATIONS

In preparation for the EPSCoR 2030 Workshop, a survey was conducted of EPSCoR universities' Presidents, Vice Presidents for Research, and EPSCoR State Project Directors to determine the impact of NSF EPSCoR, and actions that could strengthen the program. In addition, a series of meetings and discussions were held with the EPSCoR community, and a number of White Papers were authored by nationally competitive scientists. The following draft set of recommendations were synthesized from these inputs.

#### **General Recommendations/Comments:**

**Utilize a Quality within Context Concept:** In its review processes, NSF EPSCoR should return to the “quality within context” concept. That is, do not compare the relatively large states that have recently entered the program (i.e., New Mexico, Iowa, Tennessee, and now Missouri) with Wyoming, Vermont, and the Dakotas. There is a significant difference in the size of available S&E resources that can be brought to bear on the EPSCoR Research Infrastructure Improvement Awards.

**Invest in Cyber Infrastructure/Close Cyber Infrastructure Gap:** A significant investment continues to be needed to close the “cyber gap” in EPSCoR states. The costs of developing cyberinfrastructure-related network connections are generally higher in EPSCoR states because of distances from available Broadband connections. The need to increase the NSF EPSCoR budget is largely tied to cyberinfrastructure issues. EPSCoR researchers are already experiencing difficulty in competing for large NSF cyber-related awards and computational science because of lack of access to the Terra Grid. This gap places the EPSCoR states at a disadvantage when competing for Federal funding which requires a well-developed cyberinfrastructure. It also places EPSCoR states at a disadvantage (1) when trying to attract nationally competitive researchers whose work contributes to the nation’s competitiveness and innovation goals, (2) when connecting research collaborators who are located on other campuses or in other states, and (3) when attracting high-tech companies that depend on cyberinfrastructure and competitive faculty who conduct computational research.

Networking is particularly expensive for EPSCoR states since they are predominately rural, sparsely populated, and therefore not a large market to the network providers. Most of the non-EPSCoR states have been able to build up their infrastructures through local funds. A recent study shows that all of the non-EPSCoR states have a broadband fiber optical network, which is either built up through state funds or by the network providers themselves, since these companies can make a profit in the more heavily populated areas.

**Flexible Funding Mechanism:** At every level in all of the Pre-workshop Meetings, it was clear that there is a desire for a new funding mechanism that could take advantage of opportunities that arise during the five year interval between RII awards. When a \$20 million dollar EPSCoR grant is divided up among 2 to 6 institutions and multiple departments, funds are largely locked down for the 5-year duration of the award. It would be extremely helpful to all EPSCoR states if NSF would consider a mechanism(s) to take advantage of these new opportunities. For example, with this flexibility, faculty could apply to EPSCoR for funding to participate in international collaborations. On another level, EPSCoR could help its states pool resources to create a critical mass of scientific talent to pursue funding in an emerging area.

**Continue to Implement 2020 Recommendations:** There was also very strong consensus that some of the Recommendations of the 2020 EPSCoR Workshop which have not been implemented should be reviewed. There are two chief areas where this general comment would apply. EPSCoR should be a “test bed” for NSF, and the non-EPSCoR programs of NSF need to take a greater degree of ownership in promoting geographical diversity. There is concern that as one looks at NSF Directorate Advisory Committees, the 29 EPSCoR jurisdictions are not adequately represented. This impacts our researchers’ ability to understand where NSF is headed, what’s “hot” in terms of funding.

Recognize EPSCoR for the true role that it has come to play: it is the principal means of ensuring that a national research community exists in which all states can participate. It is the principal means of ensuring that NSF funding does not become even more concentrated than it already is. EPSCoR is the principal means of ensuring that all states benefit from the fruits of research which enable a state to address local and regional issues requiring a scientific response, deliver the education and training needed and contribute to the economic betterment of the community.

**New States:** Ensure a steady and sufficient level of funding that takes account of the costs of adding new states. These states tend to be larger, more competitive and better positioned than the traditional EPSCoR states and can drain large sums quickly (especially through co-funding) from the smaller states.

Recognize NSF and NIH as the agencies for basic research that must help build the infrastructure for these states to be successful in the mission agencies and encourage collaboration with the mission agencies.

**Specific Programmatic Recommendations:**

- (1) Continue the Research Infrastructure Improvement Awards (RII) as the centerpiece of the program; without this there can be little real advancement in infrastructure development and capacity. The RIIs have had the greatest impact on the EPSCoR states.

As each state committee develops its EPSCoR effort, it would be helpful to understand the guidelines that the review panels are given. Many of the states commented that both in written reviews from the Proposal processes and in comments from Reverse Site Visit Teams it was clear that some of the reviewers had no knowledge of the broad issues driving the states’ EPSCoR activities. How can reviewers in Washington comment on states issues without some “education” process?

- (2) Develop a mechanism for addressing special opportunities that arise during the 5-year RII period and that were unknown/unconsidered in the RII.
- (3) Allow for the use of experts from non-EPSCoR states in EPSCoR programs where appropriate.
- (4) Develop a means for encouraging realistic collaborations among EPSCoR states (as opposed to forced ones) in order to address regional or subject-specific issues.
- (5) Ensure that co-funding is used to benefit all states and to advance capacity-building as opposed to a response to whatever arises.
- (6) Undertake a new effort to include researchers from EPSCoR states on advisory and peer review committees and in other venues in which NSF may have a role.

- (7) Develop a better means of instructing reviewers of EPSCoR proposals on the special nature and aspects of the EPSCoR programs. Reviewers should have an understanding of how to construct infrastructure-building programs and have some familiarity with the challenges to research development in the EPSCoR states.
- (8) Ensure that EPSCoR states have the cyber-infrastructure to fully engage in research around the nation and world and that EPSCoR researchers are full participants in programs such as TeraGrid and its follow-on.
- (9) Arrange for dedicated workshops for young faculty in EPSCoR states to familiarize them with NSF procedures and upcoming solicitations.
- (10) Encourage the larger research community to involve EPSCoR researchers by providing special points for including EPSCoR researchers in S&T, ERC, MRSEC and similar competitions.
- (11) Encourage the continuing and expanded use of SBIRs as a means of technological development by assuring that the SBIR “tax” on the EPSCoR program is spent in the EPSCoR states and that technical assistance and support is available to enable EPSCoR states to pursue SBIRs and STTRs.
- (12) Include a “traineeship” component in EPSCoR programs that is awarded to an institution or project in an EPSCoR state (and non-portable) so that funding is available to support graduate students.
- (13) Do not require every program award to address every core value at NSF but rather, target specific infrastructure needs and fully support those with limited funds available.
- (14) Provide outreach and education components of EPSCoR through a separate funding mechanism designed specifically for EPSCoR jurisdictions.
- (15) NSF EPSCoR’s eligibility criteria need to be updated. These criteria are based on agency funding levels. In recent years, these criteria have permitted a steady increase in the number of jurisdictions participating in the program from 19 in 1998 to 29 currently in 2011. This ongoing increase dilutes EPSCoR’s focus and resources; that is, eligibility expansion has created tiers of states with markedly different research resources, competing within the same program for infrastructure improvement, and for which the overall impact to states’ competitiveness will be dramatically different.

# ATTACHMENT 4

## EPSCoR 2030 WORKSHOP

### WHITE PAPERS

**Gwen A. Jacobs**

#### **EPSCoR 2030: Strategic investments in cyberinfrastructure to sustain research competitiveness in EPSCoR states**

#### **The Challenge**

The EPSCoR Research Infrastructure Program (RII) has enabled many state universities and colleges to develop their research potential and capacity through investments in new faculty, research instrumentation and core facilities, student research opportunities and outreach to citizens within their states. Many states have leveraged these investments into vibrant, successful research programs led by excellent faculty that can address critical state needs in research and economic development.

These successful research programs have grown and matured during a time when scientific research has evolved beyond theory and experiment into a new paradigm that depends increasingly on computational and data intensive approaches. The tools and infrastructure necessary to remain competitive in this new arena are changing rapidly, requiring major investments in cyberinfrastructure (CI) to meet growing needs in computation, data management, visualization and high speed, high bandwidth networking.

Many institutions in non-EPSCoR states (Indiana University, MIT, CalTech, UCSD, Princeton, Purdue, Cornell) have made major investments in CI as a core research facility and have well-developed research computing centers with computational resources, services and professional staff that provide expertise and support to all researchers on campus. EPSCoR institutions that have lagged behind this trend have widely distributed and poorly organized CI support where departments, research groups and individual investigators create their own isolated, stand-alone CI platforms. Faculty and students waste valuable research time maintaining their own systems and lack the expertise to use the technology effectively.

EPSCoR institutions and states must act now to develop robust, sustainable CI to insure that their faculty and research programs remain competitive. Without strategic action, EPSCoR states stand to lose significant investments in intellectual capital and research capacity, as the best and brightest scientists are attracted to institutions fully capable of supporting their research.

How can EPSCoR states and the EPSCoR program address this challenge? Two critical steps are essential:

- (1) EPSCoR states must develop strategic plans for investing and implementing CI at the institutional, system and statewide level.
- (2) The EPSCoR program must develop more flexible funding models that allow states to reach their CI goals and maintain their research competitiveness nationwide.

The following sections contain suggestions for creating an institutional and state strategic plan for CI and changes to the current EPSCoR funding mechanisms to achieve institutional goals.

EPSCoR states must develop strategic plans for investing and implementing CI at the institutional, system and statewide level.

**A comprehensive CI includes:** access to campus, regional, national and international networks, high performance computing, data management, analysis and visualization, software tools and systems and professional staff to develop and maintain the infrastructure and enable researchers and students to use it in their research. All states need all of these types of CI, however their relative needs can vary widely based on geographical location, research focus, previous institutional research investments and institutional investments in the campus IT infrastructure. The following are some basic steps to address this need:

- Develop a strategic plan for CI at the institutional and state levels
  - o This plan must be endorsed and supported by the highest levels of academic leadership with active participation of the Research VP, Provost, Chief Information Officer and College Deans.
  - o At the institutional level, each strategic plan should support a coherent CI that maximizes and aggregates CI investments with plans for long-term support of both the human and physical components.
  - o The State CI strategic plan should integrate institutional investments with regional and national CI efforts.
- Leverage multiple funding mechanisms to support the CI plan
  - o No single funding program can fully support and sustain the CI needs of an institution. Funding from different agency programs designed to support the development of research capacity should be used to support institutional CI.
  - o Programs such as NSF EPSCoR -Track 1, 2 and C2, ARI, MRI, DoD EPSCoR, Department of Agriculture EPSCoR, NIH (INBRE, COBRE) all provide funding that could be used to contribute to a set of centralized CI resources. These investments should be guided by the institutional strategic plan for CI and every effort should be made to maximize the investment to the benefit of the entire campus.
- Aggregate CI resources to increase capacity and cut costs
  - o Institutions should aggregate distributed resources centrally and provide faculty with set of research resources, as a service to support their computational and data storage needs.
  - o Aggregation will help curb energy costs, improve security and access and promote a sustainable business model for ongoing support that includes partial institutional support, user fees, indirect costs and direct costs from grants.
  - o Faculty can invest their grant funds in a set of shared resources that will insure availability and leverage other institutional investments.
- Provide long term funding for professional staff
  - o Professional staff are the most valuable component of institutional CI and should be actively recruited and supported long-term as essential members of the scientific workforce at the institution.
  - o These individuals have a very different set of skills (compared to campus IT staff) that allow them to maintain the CI research environment as well as provide expertise to faculty in computational approaches, data management and visualization.
  - o Their role should encompass support for CI software that meets national standards for authentication and access control, cyber security, management of computer clusters, data storage and management, parallel computing libraries, network performance analysis, collaboration tools and scientific visualization.

The EPSCoR program must develop more flexible funding models that allow states to reach their CI goals and maintain their research competitiveness nationwide. The current Track 1 Track 2 and C2 EPSCoR programs, while focused on developing research capacity and CI respectively all require the same sets of deliverables – research, infrastructure development, and education, outreach and diversity. This broad set of requirements dilutes the potential impact of a major award, by spreading funds too thinly, often across multiple institutions. A modified approach could allow states to choose to concentrate their proposals on fewer requirements and focus their investment to meet state and institutional needs in research, workforce development or diversity efforts. The following are some suggestions for funding models to support the development of a sustainable CI for EPSCoR states and institutions:

- Develop programs to support core CI needs: Few funding opportunities are designed to support the development the basic core CI necessary for research-intensive institutions. A sustained EPSCoR program, such as the Track2, aimed at helping institutions develop a robust CI would enable institutions to jump start strategic investments in CI and develop sustainable business models. This program should focus on developing the CI to support research broadly and adopt community standards, rather than be based on the support of a specific science focus, which could limit the institutional impact. The program should support all types of CI, and most importantly emphasize the recruitment and training of professional CI staff. Examples of core CI needs for EPSCoR states include: ]
  - o Networking: EPSCoR Institutions in the Northeast, West, Hawai'i and Alaska have struggled for years to achieve parity in network connectivity due to their geographical locations and low population density. Tribal colleges, terrestrial and marine stations in rural areas are often very poorly connected due to cost issues or lack of available network hubs nearby.

Addressing these needs simply costs more for these states than others. Despite national investments through the NTIA/BTOP program as well as the EPSCoR C2 program, these networking needs are ongoing. Improving campus networks and last mile connectivity continues to be a significant need. Institutions that have not made these investments create major challenges for researchers who require access to remote resources, work with large data sets or are involved in national and international collaborations. The award amounts for these programs should reflect the relative costs of building out networks in underserved and geographically isolated regions.

- o Computational Resources: Institutions with research strengths in computational sciences require investments in computing clusters, supercomputers and visualization environments to support their faculty. Funding for professional staff to maintain these facilities and educate and support users should be included. These resources should be available to investigators throughout the state and managed as an institutional resource.
- o Data Management: NSF has taken an essential step forward to promote the sharing and reuse of data by the scientific community. However, many investigators are challenged to find or develop appropriate tools, best practices and community standards to meet these new requirements. Many institutions lack faculty or professional staff with skills in data curation as well as the basic types of software infrastructure, such as databases and curation tools. Another significant challenge is developing the hardware infrastructure for storing the very large volumes of data generated by sensor networks, high throughput sequencing, modeling and simulation and imaging. A program to help institutions develop and staff an effective data management strategy would be highly beneficial.
- o Professional Staff: There is a national shortage of individuals who have the requisite skill set to deploy and support institutional CI. Smaller institutions, tribal colleges and minority serving institutions rarely have any highly skilled staff to maintain their research infrastructure. A program to recruit, educate and retain professional CI staff that can become part of the scientific workforce is essential for EPSCoR institutions.

- Create opportunities for multi-jurisdictional collaborations: Although all institutions require all types of CI, there are tremendous opportunities to develop shared CI resources across EPSCoR jurisdictions. Many EPSCoR states have complimentary research or CI strengths that could be combined into a very effective multi-jurisdiction consortium. Individual states could focus on developing a data center, or invest in supercomputing resources; others could focus on developing needed expertise in software development or visualization. The consortium could adopt community standards for CI development and share expertise and training opportunities across jurisdictions. A funding mechanism that supports a multi-institutional consortium across EPSCoR jurisdictions, similar to a Science and Technology Center award could have an immense impact on the productivity of EPSCoR regions.
- Provide workshops for proposal development in new funding areas: Many EPSCoR states lack significant expertise in many types of CI to develop effective proposals in response to funding opportunities. Partnering with other EPSCoR institutions can leverage multi-state expertise, however, ample time to identify complimentary strengths and develop a strong partnership is necessary. Workshops to educate the EPSCoR community on emerging CI efforts would provide great opportunities to combine efforts across institutions. The 90-day response time is too short to develop a complex proposal involving multiple partners. These changes to the proposal process will result in higher quality more competitive proposals.
- Develop programs to link EPSCoR institutions with major NSF efforts: Many EPSCoR states should be part of national funding efforts, such as NEON, DataNet and more recently EarthCube. Competition for funds in these programs is fierce and the large awards typically go to top tier institutions in non-EPSCoR states. EPSCoR could provide separate funding for states to join these large efforts, thereby bringing talented EPSCoR researchers into these national efforts.

There is a growing nationwide concern over the status and sustainability of our national CI voiced by leaders within the CI community. Many of these recommendations are included in several excellent reports from the NSF Advisory Council for Cyberinfrastructure. The NSF EPSCoR program has a significant opportunity to address these critical needs for EPSCoR states and thereby impact transformative research nationwide.

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**Power in Planning**

William Gern, University of Wyoming

All jurisdictions participating in the NSF EPSCoR and the NIH IDeA programs share a common goal of building research infrastructure. Beyond this shared mission, jurisdictions vary widely in individual characteristics that determine infrastructure needs. Here are a few salient examples to demonstrate this fact.

State	Size in Square Miles	% Federal ownership	Population 2010 Census	Population Density/mi <sup>2</sup>	# of Institutions of Granting Graduate Degrees <sup>1</sup>
Alaska	6,663,267	67.0%	721,523	0.1	3
Delaware	2,489	2.5%	900,877	362	4
Hawai'i	10,931	18.4%	1,366,862	125	4
Montana	147,042	31.9%	994,416	6.8	7
Nevada	110,560	87.6%	2,709,432	25	4
Rhode Island	1,545	3.9%	1,055,247	683	9
Tennessee	42,144	7.6%	6,375,431	151	31
West Virginia	23,230	13.6%	1,859,815	80	15
Wyoming	97,813	49.7%	568,300	5.8	

<sup>1</sup>Data from <http://www.utexas.edu/world/university/state/>; does not include institutions granting advanced divinity or theology degrees. In some cases medical schools are included with a central university and in others they are separate.

EPSCoR/IDeA programs strive to support the growth of research infrastructure and promote greater research capacity in these jurisdictions to reduce the disparity seen nationally in Federal R&D expenditures. According to the National Science Foundation's Science and Engineering Indicators, 2010, (Table 8-34), the 30 designated EPSCoR jurisdictions<sup>2</sup> had a little more than \$14.6 billion (13.1%) in Federal R&D obligations, with the 23 other states holding slightly more than \$96.6 billion (86.9%) in obligations out of the U.S. total (\$111.2 billion). Within this important goal of equalizing resources, EPSCoR/IDeA programs must remain cognizant of the diversity of R&D planning processes that occur in each unique jurisdiction.

While the proximate goal of EPSCoR/IDeA initiatives may be increasing research capacity within colleges and universities through increased federal R&D funding, the ultimate goal is to support economic diversification through supporting technology-related business formation and growth. The importance of research and economic diversification is well described in the National Academy of Science's Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future. For federal programs to accomplish the goals of research infrastructure building and economic diversification there must be strong federal and state commitments. Recognizing this, the NSF mandated that Science and Technology (S&T) Plans would be required for successful application to the NSF EPSCoR Research Infrastructure Initiative (RII) Track 1 funding opportunity. For many jurisdictions, science and technology planning had already been used to guide the research enterprise.

In Wyoming, with a single institution granting graduate degrees, state S&T planning was directed initially by the University of Wyoming through its University Planning process. Over the past 15 years, a series of three, 5-year intricate and diverse plans spanning two separate administrations has guided the strategic growth of the University, including technology-related business growth for the state emanating from the University. In 2010, a new State S&T Plan intermeshed the University plan with the strategic plan of the Wyoming Business Council. This new state plan developed through a series of focus group meetings of 25 state, federal, county and private entities. The Wyoming S&T Plan unites goals in *energy development* (Wyoming leads the nation in energy production with more than 10 quadrillion Btu's produced annually), *water utilization* (Wyoming is the headwaters for the Missouri, the Colorado, and the Snake/Columbia systems providing water to approximately 1/3 of the U.S. land mass), and *computational science*.

The three major R&D areas central to the Wyoming S&T plan are intimately linked. Wyoming ranks second in natural gas production; much of that gas is produced through the use of hydraulic fracturing, a process that must be carefully accomplished to avoid contamination of the water table. Thus, research understanding hydrology related to geophysics of the subsurface is essential. Accurate subsurface models examining fluid flow in porous media will enhance the production of natural gas and describe the relationships of gas reservoirs with aquifers of potable water. These processes occur at such large scales that highly scalable models are required for full data analysis. Such complex models require major computing resources and large bandwidths: hence, the third leg of the Wyoming S&T plan was articulated in the area of computational science.

Working with the NSF, the National Center for Atmospheric Research (NCAR) and its operating entity, the University Corporation for Atmospheric Research (UCAR), the State of Wyoming, Cheyenne LEADS (the local economic development entity) and UW a major relationship was developed to build the next generation of supercomputing for NCAR near Cheyenne. Wyoming allocated \$20 million in construction funding and another \$20 million over 20 years for computer acquisition support to the facility. This petaFLOP scale computer is a major resource for atmospheric and climate scientists throughout the nation. Wyoming receives a 20% annual allocation of the NSF-funded computational resource for the next twenty years. While not required, Wyoming will also labor to share this allocation with scientists in other EPSCoR jurisdictions. Due to University, state and local economic development planning, Wyoming was well positioned to compete successfully for this important federal computing center. UW's planning called for development of the computational sciences with emphasis in subsurface fluid flow, resulting in the placement of 25 computational scientists in tenure track positions at UW over the last 12 years and this continues.

The State had also planned extensively to increase power availability and optical networks to attract cyber-related business. One of the nation's largest tracks of privately owned optical fiber traverses the I-80 corridor. Local economic developers are focusing on IT-related businesses and are actively recruiting such businesses. This State emphasis also drove the careful planning by NCAR and UW, and provided good justification for the selection of southeastern Wyoming as the site for the NCAR-Wyoming- Supercomputing Center (NWSC). The decision was based in part on the cool climate with low relative humidity in the region, which is ideal for high capacity computers. Additionally, the abundant power and significant optic fiber resources allow the NWSC to operate very economically.

The emphasis on supercomputing is important for the future economy of Wyoming because it couples the traditional economic areas of mineral extraction and water utilization with the cyber-economy. The placement of the NWSC has attracted major U.S. corporations to consider southeastern Wyoming as a site for new ventures. New jobs are currently being created and research is burgeoning. Thus, the long history of careful planning has worked ideally in Wyoming. And it works successfully in many other jurisdictions as well. In Delaware, the NSF EPSCoR and the NIH-IDEA program have been key catalytic programs that were strategically integrated with the statewide S&T Plan, which carefully evaluated the strengths and opportunities for broad, knowledge-based economic development. Originally launched in the late 1990's, with strong support by leaders from the academic, public and private sector, the plan called for the development of a sustainable life sciences sector in the state. A decade later, Delaware's life sciences sector supports 28,000 jobs, an industry that provides significant economic benefit to the state.

Planning works, but change implemented through planning takes time, especially at the large scales mandated by NSF EPSCoR. State plans outline the science and technology goals and aspirations of a given jurisdiction. The diversity of jurisdictions, however, requires that federal EPSCoR/IDEA programs must be flexible. Programmatic review must occur within the context of each jurisdiction's unique economic environment and research enterprise. Contextual review must be maintained if federal programs are to achieve the maximum desired goals of economic diversification through building research and development capacity.

<sup>2</sup>EPSCoR/IDEA Jurisdictions are determined by each agency based on their own criteria. For ease in this case, EPSCoR Jurisdictions are those of the NSF and in addition to 28 states include Puerto Rico and the U.S. Virgin Islands.

**Some Thoughts on the Future of EPSCoR**  
**K. L. Olsen, Ph.D**

EPSCoR (the Experimental Program to Stimulate Competitive Research) was established to **ensure our Nation's ongoing excellence** in science, engineering and technology. Today's global challenges require that our nation utilize all of our talent to maximize entrepreneurship and innovation; and research shows that including the broadest participation and diversity of perspectives makes us responsive, creative, and resilient. EPSCoR is essential towards achieving these goals, and therefore must be a priority and aligned across the Foundation in accordance with these principles. One only needs to look at the five core values that are outlined in the National Science Foundation Strategic Plan (FY 2011-2016: *Empowering the Nation through Discovery and Innovation*) to recognize why the success of EPSCoR is paramount for the success of NSF's mission. *Visionary* includes "realizing the full potential of the research and education community and advancing promising ideas wherever and when even they arise." *Dedicated to Excellence* includes "realizing the full potential of our people." *Learning and Growing* is about identifying opportunities for the growth of the S&E community. *Broadly Inclusive* is about "seeking and including contributions from all sources...across the nation and exploring opportunities for partnerships." And, *Accountability* is "operating with integrity and transparency."

Since its inception in 1978, NSF EPSCoR has been very successful in building needed infrastructure and research capacity within the states and regions, as well as training and producing the necessary talent—S&T workers, entrepreneurs and leaders—needed for our nation's competitiveness. The strength of the NSF Program is its continued evolution of funding mechanisms to address today's needs and opportunities, optimizing the capacity for building and sustaining our Nation's research and education enterprise. This workshop, along with the "EPSCoR 2020" vision report, are ways that the community can discuss, provide recommendations and identify issues that go to the heart of our Nation's innovation system, as well as promote NSF Core Values and mission for the progress of science.

Towards this goal, I urge consideration of the following five comments and recommendations:

- I suggest that there is a need of a new investment strategy or a new track within existing EPSCoR **Research Infrastructure Improvement Program** to build on the core successes and strategic goals within an institution. That is, EPSCoR has been able to foster excellence in specific key research areas across the state. However, to maintain competitiveness those interdisciplinary research and education foci need to be developed further and enhanced with targeted investments within an institution.
- Given the importance of globalization and internationalization of science and engineering research (see NSB 2010 Companion to Science and Indicators Indicators), there is a need for a new mechanism within EPSCoR to supplement opportunities for faculty, especially in their early career, to gain an intensive international experience. This supplement would provide support for the faculty to be globally competitive via extended international collaboration.
- Social, behavioral and economic sciences (SBE) have become increasingly central to solving global challenges across all areas of science, engineering and technology. From understanding entrepreneurship, to dissecting complex systems, to analyzing human decision making in our postindustrial, knowledge-based future; strengths in SBE research are paramount. Workshops in these areas should be supported and proposals that incorporate SBE should be encouraged and considered a priority.
- We all have unconscious bias. All too easily, they can be unintentionally reflected within the merit review process. Therefore, to fully capitalize on the strengths of diversity, it is necessary to implement explicit mechanisms that have been shown to be effective in addressing full participation. This must include geographic regions and types of institutions along with "the usual suspects".

- One of the strengths of NSF is its close rapport with the Nation's research and education community through their service on Directorate and Office advisory committees as well as proposal review panels, workshops, etc. The high visibility of these activities and their critical role in shaping the research and education enterprise make it imperative that these committees also reflect NSF core values and include broad participation across all regions and types of institutions. The Office of the Director should bear the final accountability for this.

### **The Catalytic Impact of EPSCoR and IDeA on Delaware**

Over the past decade, two federal programs have catalyzed significant cultural changes in Delaware, encompassing research, research-based education, innovation and entrepreneurship, and technology-based economic development, such that Delaware's academic institutions now play a significant leadership role in the economic prosperity of the State.

The two federal programs are the NSF-funded Experimental Program to Stimulate Competitive Research (EPSCoR) and the NIH-funded IDeA Network of Biomedical Research Excellence (INBRE). Delaware is leveraging the complementary nature of these two programs to develop a coordinated, statewide program with far-reaching impact.

With significant financial support from the University, the state and the private sector, the Delaware Biotechnology Institute was established at the University of Delaware to serve as the lead institution for a statewide partnership among government, academia and industry. The first step was to establish the First State as a center of excellence in biotechnology and the life sciences. The Institute's mission was to facilitate a biotechnology network of people and facilities to enhance existing academic and private-sector research, catalyze unique cross-disciplinary research and education initiatives, and to foster the entrepreneurship that creates high-quality jobs.

With the integral support of EPSCoR and INBRE an academic and economic development ecosystem is being developed. For example, a State Science & Technology Plan was established by Executive Order of the Governor, and chaired by the Lt. Governor, with strong participation of leaders from the private, public and academic sector. The resulting recommendation of the S&T Plan focused on human health, environmental sustainability, renewable energy, cyberinfrastructure and national defense. Many of these key recommendations have since been implemented, catalyzed to a large extent by EPSCoR and INBRE resources. Other components of the economic ecosystem include the Delaware Environmental Institute (DENIN), the Delaware Health Sciences Alliance (DHSA), the Office of Economic Innovation and Partnerships (OEIP), which provides coordinated access to IP, and the Center for Integrated Biological and Environmental Research (CIBER).

Over the past 15 years, NSF funding awarded to Delaware institutions has tripled and NIH funding to Delaware has five-folded. The strategic investments of EPSCoR and INBRE, with their specific focus on infrastructure development, which for Delaware includes people, processes, facilities and partnerships, have played a key role in this dramatic increase.

Today in Delaware, 28,000 jobs depend on pharmaceutical and biotech research, an industry that generates \$6 Billion a year into the State's economy and pays millions in state and local taxes. A diverse bioscience industrial segment has been created, anchored by such global enterprises as DuPont, AstraZeneca, Gore and Siemens, and supplemented by dozens of small and midsize companies. As the economic ecosystem has developed, other business segments are emerging, including alternative energy sources, environmental sustainability and others.

As a small state, Delaware has adjusted its strategy toward not competing head-to-head with the larger states that surround it, but by focusing on its inherent strengths – building close partnerships, understanding partner needs and developing unique programs that meet additional needs to create a long-term economic benefit.

**Unique Position of EPSCoR**  
**Kristin Bowman-James**  
Project Director, Kansas NSF EPSCoR

As funds for research became less available in the 1960s and 1970s, federal agencies focused more on funding research in the major universities in the Ivy League, some mid-continent, such as Purdue and Northwestern, and those in the west, such as Caltech and Berkeley. The rationale was that these institutions attracted the most promising scientists and engineers as faculty, and the best and most capable students. Indeed, there are those who suggest that this is how it should be, with a limited number of truly research-oriented institutions. In fact, awarding the majority of funding to the absolute “top tier” of universities follows a rule known in chemical circles as Markovnikoff’s Rule, or basically “Them that has, gets.” However, not only does this strategy leave a huge talent pool behind in terms of STEM students, it also does not take advantage of the intellectual capabilities of the many faculty, who, for one reason or another, do not find themselves at the Caltechs, Berkeleys, or Harvards. EPSCoR has a unique role to play in allowing the full potential of this enormous talent pool to be utilized.

For the last 30+ years NSF EPSCoR has provided infrastructure-building support for states with traditionally less federal funding, with a goal of providing the foundations for a sustainable future in the research enterprise. Many states, including our own, have talked about graduation. However, perhaps graduation should not be the only focus. The focus should also be on the answer to the question: What can these jurisdictions uniquely contribute to science and technology in today’s society? One answer is that these jurisdictions are home to many of the minority serving institutions, including tribal colleges (22 out of 32  $\approx$  69 %) and HBCUs (50 out of 105  $\approx$  50 %). Our society cannot afford to overlook the potential contributions of children in our country who have not had the privilege to have been born into an affluent family, who are first generation college goers, and/or who are in underrepresented ethnic, racial, or otherwise disadvantaged groups.

Another answer to the aforementioned question is that the experimental aspect of EPSCoR can provide the seedlings for new fields or programs not available from other funding avenues, building on the core sciences in the various jurisdictions. Kansas NSF EPSCoR has provided such funding in the 1990s for prototype projects that led to an ERC in the early 2000s - the Center for Environmentally Beneficial Catalysis (CEBC), and an STC several years later - the Center for Remote Sensing of Ice Sheets (CRISIS). The Center for Plant Lipid Systems, now a multi-state initiative, and the Ecological Genomics Institute, a new slant on the fields of ecology and genomics, also grew out of NSF EPSCoR funding from 2003-2006. Additionally, the Kansas NSF EPSCoR-funded Pathways for Native Americans project (also called Climate Change in Native American Communities) is a unique new program that works with Native American students to introduce them to scientific research methods and the science behind climate and climate change issues. While this program currently funds only 10-12 undergraduate Native American students to come to Haskell Indian Nations University each summer from tribal colleges all over the United States, including Alaska and Hawaii, it serves as a prototype for expanded programs that can build on the foundations it provides. Some of the graduates have already gone on to obtain higher education degrees, but perhaps as important, others are destined to be leaders in their own communities, and return home with a better understanding of the role science plays in their daily lives and well-being.

In conclusion, if any institutions are poised to make an impact on the future S&T workforce and new and exciting new initiatives, it is those in EPSCoR states. The question now becomes what is the next level for NSF EPSCoR, i.e., where can EPSCoR jurisdictions truly be competitive? Perhaps it lies in combined science and education initiatives that impact both science and workforce development from a much higher vantage point, such as multi-jurisdictional Institutes for Workforce Development, built on solid frameworks of the core science strengths of participating states.

EPSCoR 2030:  
A REPORT TO THE  
NATIONAL SCIENCE FOUNDATION