# Experimental Program to Stimulate Competitive Research (EPSCoR)

## Portfolio Description

This activity supports basic research spanning the broad range of science and technology programs at DOE in states that have historically received relatively less Federal research funding. The currently eligible EPSCoR states are listed at http://www.nsf.gov/od/oia/programs/epscor/eligible.jsp. The research supported by EPSCoR includes materials sciences, chemical sciences, physics, energy-relevant biological sciences, geological and environmental sciences, high energy physics, nuclear physics, fusion energy sciences, advanced computing, and the basic sciences underpinning fossil energy, nuclear energy, energy efficiency, electricity delivery, and renewable energy.

## Unique Aspects

The program objective is accomplished by sponsoring two types of grants: (1) Implementation Grants and (2) State-Laboratory grants. Implementation grants address state/territory capability and infrastructure development through funding research in a focused area or research cluster with the potential to support faculty hires, a group of students or postdoctoral fellows, and the purchase of research equipment. Implementation grants are for a maximum period of six years with an initial grant period of three years. The State-Laboratory grants address building partnerships between the researchers in EPSCoR institutions, their students and postdoctoral fellows with research scientists and unique capabilities at DOE national laboratories. The State-Laboratory grants are for one period of three years.

EPSCoR has placed a high priority on promoting strong research collaboration and training of students at the DOE national laboratories where unique, world-class facilities are available. This program is science-driven and supports the most meritorious proposals based on peer review and programmatic priorities. Discussions are held with representative scientists from EPSCoR states to acquaint them with the facilities and personnel at the DOE national laboratories.

## Relationship to Other Programs

The activity interfaces with all other research activities within BES. In addition, it is responsive to programmatic needs of other program offices within DOE. Most of the research clusters that have graduated from the DOE EPSCoR program after six years of funding have found alternate funding for continuing the research activity. This demonstrates that the research clusters funded by EPSCoR are becoming competitive. In addition, EPSCoR grants are supporting graduate students, undergraduates, and postdoctoral associates, and encouraging them to be trained in frontier research areas by making use of world-class research facilities at the DOE National Laboratories. The work supported by the EPSCoR program impacts all DOE mission areas including research in materials sciences, chemical sciences, biological and environmental sciences, high energy and nuclear physics, fusion energy sciences, advanced computer sciences, fossil energy sciences, and energy efficiency and renewable energy sciences.

## Significant Accomplishments

The EPSCoR program funds basic research in support of all programmatic needs of DOE. Select accomplishments are presented, grouped according to the relevant DOE program office.

Basic Energy Sciences

- A group at the University of Oklahoma is in the race to measure the electric dipole moment of the electron. Approximately 20 groups world-wide are seeking to measure this important fundamental property that will allow the world to assign a size to the electron. Current experimental limits already show that the ratio of size of an electron to the size of a proton is less than the ratio of the size of an ant to the distance between the Earth and Sun. Specifically, the size of the electron differentiates between many competing models of how particles interact. These models include the venerable Standard Model of Physics and the newer Super Symmetric Theories. Using a lead fluoride molecule researchers at the University of Oklahoma are helping to differentiate these models (N. Shafer-Ray, U. Oklahoma).

- Thermal energy exists in many forms ranging from solar energy to waste heat from existing power sources. For example, over 70% of the input power into an automobile engine is lost, a large majority of the loss in the form of waste heat. One way to harness thermal energy is through the use of thermoelectric materials and devices that enable us to transform this thermal energy into usable high quality electrical energy. Research in current thermoelectric materials is attempting to significantly increasing their efficiency. Over the past decade, significant advances have been achieved in low dimensional structures such as superlattices and quantum dots. New investigations by researchers in South Carolina using novel nanostructures and nanocomposites including exotic "cage structure" materials consist of matrices of bulk and nanomaterials are offering to nearly double the performance of low-dimensional materials. Such improved performance and continued development of high efficiency thermoelectric nanocomposites may provide environmentally safe and reliable power sources to sustain the nation's future (T. M. Tritt, Clemson University).

Biological and Environmental Research

- Most doses of radiation exposures associated with human activity are predicted low dose in nature. These may arise from medical diagnostics, hazardous waste abatement, power systems operation, and even terrorist acts such as dirty bombs. While the precise risk of exposure continues to be debated, recent findings indicate that a measurable risk exists even at very low doses. By measuring gene activity before and after exposure, researchers in Tennessee are working to identify biological pathways that are activated or repressed in response to the radiation insult. Work at the University of Tennessee on *in situ* gene expression is enhancing our understanding of low dose radiation's effects at all levels of biological organization, from genes to cells to tissues and finally to complex organisms such as humans. Understanding the risks to human health associated with low dose radiation is critical if we are to protect the nation's workforce while making the most effective use of national resources (M. A. Langston, U. Tennessee).

Fossil Energy

- Coal has a wide variety of trace elements such as arsenic, selenium and antimony that can have undesirable environmental consequences. In order to mitigate this potential hazard, it is important to develop a fundamental understanding of how these trace elements are partitioned in the combustion products between the gas phase and particulate matter. To correctly predict how this partitioning occurs, the generation of currently unavailable thermodynamic and kinetic data is required. Researchers in North Dakota are performing novel experiments to generate this data for these hazardous trace elements as well as for major elements, such as calcium, iron, and aluminum, over melts that replicate the solid surfaces of ash particles. Computational calculations have also been performed to compare the thermodynamic stabilities of compounds of these trace elements. Ab initio calculations suggest that oxygen-rich compounds of the trace elements are preferred to the simple oxide forms predicted by classical thermodynamic calculations. Such results are helping researchers envision the reduction of the environmental impact of burning coal (W. Seames, U. North Dakota).

**Mission Relevance**

The core activity interfaces with all other core activities within the Office of Science and DOE. It is also responsive and supports the DOE mission in the areas of energy and national security and in mitigating their associated environmental impacts.

**Scientific Challenges**

The DOE EPSCoR activity will continue to support basic research spanning the broad range of science and technology programs within DOE.

**Projected Evolution**

A recent trend has been to increase the potential award sizes of both the Implementation Grants and the State-Laboratory Grants. Future Funding Opportunity Announcements (FOAs) will incorporate Congressional language increasing the funding limit on implementation grants from $1,000,000 per year in the most recent Implementation Grant FOA to $2,500,000 per year. Another modification to the program will be removing the limitation of one implementation award per EPSCoR state. Maximum funding for State-Laboratory grants has been increased from $150,000 per year to $200,000 per year in the most recent FOA. These changes will allow for more rapid capability development at EPSCoR institutions and enable increased contact time and improved collaborations between the EPSCoR research scientists and DOE National Laboratories. An additional change is that FOAs beginning with FY 2009 do not require state matching funds.