Oral Testimony by Dr. Patricia M. Dehmer
Deputy Director for Science Programs
Office of Science
U.S. Department of Energy

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Committee on Science and Technology
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Regarding the Basic Energy Sciences Program Reauthorization

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Mr. Chairman, Ranking Member Inglis, and Members of the Committee:

Thank you for inviting me to testify on the Basic Energy Sciences program. I served as the director of that program for 12 years, from 1995 through 2007.

The program has two components.

The first is fundamental research structured to address DOE's missions, primarily its energy mission. The research program supports nearly 5,000 Ph.D. scientists and more than 1,500 students in the disciplines of chemistry, materials sciences, and aspects of biosciences and geosciences. The new knowledge gained from this research ultimately underpins the development of new technologies.

The second component of the BES program is the design, construction, and operation of a truly remarkable collection of scientific user facilities. These facilities support the research program (1st) by producing new materials and (then) by enabling their characterization at the atomic level using beams of x-rays, neutrons, and electrons. In FY 2007, about 9,000 users visited these facilities.

During the past decade, the BES program constructed $2 billion of facilities on schedule and within budget. This included the Spallation Neutron Source, the complete reconstruction of one of our synchrotron radiation light sources from the ground up, and five Nanoscale Science Research Centers. More than $1 billion of additional facilities are now in design or construction.

This collection of facilities supported by BES is the best in the world. It is the best in the world. And it is a critical component of maintaining U.S. supremacy in the physical sciences.

The central principle of the BES program and one that I take very seriously is that discovery science is foundation of innovation and future technologies. This was the inspiration for a series of one dozen workshops, begun in 2001, that linked the basic research community, the applied research community, and industry in topics relevant to energy.

About 1500 researchers attended these workshops over a 6-year period. We also involved representatives from the DOE's National Nuclear Security Administration and all six of its technology programs.

The reports of those workshops describe what I call a new era of science — an era in which materials properties are designed to specifications and chemical reactions are manipulated at will. It is the science of control at the atomic scale. It is the science of the 21st century.

But to do this, we need knowledge that we do not yet have. I cannot overstate this. Even the simplest concepts still elude us. Here is one example:

Despite the efforts of hundreds (if not thousands) of researchers around the world, we still do not understand the mechanism of high-temperature superconductivity, which was discovered 22 years ago. There are now dozens of examples of such materials.

Why is it important that we understand this? Well, the application of superconductivity is no longer decades or even years away. Superconducting cable has been produced for some time and, earlier this summer, nearly half-mile of power cable was installed in an existing underground right of way as part of the Long Island Power Authority.

But without knowing the mechanism of high-temperature superconductivity, we are still using trial-and-error methods to develop these materials. We have no basis for the rational design of new and better materials.

This is a 20th century way of doing business. It is certainly not 21st century science. This example is replicated in virtually every energy technology – from solar energy conversion to electrical energy storage in batteries to solid state lighting. We need to enter the new era of science that our workshops described.

I'd like to close with one additional observation from the workshops. During the years of our workshops, we saw rapid growth of interdisciplinary energy and environmental science activities develop at institutions around the country – universities and national labs. Our two traditional funding mechanisms – individual-investigator and small-group awards – both focus largely on single-discipline research. In FY 2009, we modified our small-group funding mechanism to specifically address multidisciplinary groups of investigators working on very challenging problems in energy. We call these group awards "the Energy Frontier Research Centers." Together they represent a small part – about 15% – of the total research portfolio.

Mr. Chairman, thank you very much for inviting me to testify. Thank you also for your continued support for the BES program and the Office of Science. I would be pleased to answer any questions from the Committee.