On behalf of the University Corporation for Atmospheric Research (UCAR) and the university community involved in Earth sciences research and education, I submit this written testimony for the record of the Senate Committee on Appropriations, Subcommittee on Energy and Water Development, and Related Agencies. UCAR is a consortium of 76 research universities that manages and operates the National Center for Atmospheric Research (NCAR) on behalf of the National Science Foundation and the university community.

This nation must deal with critical national and global energy challenges. At a time when we need more research, technological innovation, and solutions, I am deeply troubled by the level of cuts that the U.S. House of Representatives has proposed for DOE in FY11, especially the truly destructive cuts proposed for the DOE Office of Science (DOE Science), whose basic research is among the most valuable and cross-cutting in the world. While I understand that Congress faces difficult budget choices in reining in a growing deficit, it would be a mistake for Congress to balance the budget on the back of DOE’s research and development. **I urge the Subcommittee to fund the FY 2012 budget request for the DOE Office of Science at $5.42 billion and the Office of Energy Efficiency & Renewable Energy (EERE) at $3.2 billion.**

DOE programs and initiatives in science and education directly support university and laboratory communities, funding the work of preeminent scientists in our field. Without DOE support, our capacity to understand and advance numerous fields of science, including the atmospheric sciences, would be seriously compromised. DOE is central to the country’s economic and technological world leadership and to our ability to secure an economically and environmentally sustainable future for ourselves and our children. This is why the bipartisan National Commission on Fiscal Responsibility & Reform recommended that, even amidst major agency spending cuts, the nation must continue to “expand high-value research and development in energy and other critical areas.”

**Climate and Earth System Sciences**

The Office of Biological and Environmental Research (BER) within DOE Science makes fundamental contributions to the nation’s premier Earth system models and data analysis infrastructure that provide the scientific foundation for future decision-making on environmental change. Without them we would not know the level of risk that cities, states, and businesses face from long-term weather trends and what societal preparation and adaptation might be needed.
In particular, BER provides indispensable support to the Community Earth System Model (CESM), a joint DOE-NCAR effort that is a comprehensive and sophisticated model for analyzing Earth’s past, present, and future. CESM is a major contributor to national and international assessments of environmental change. And while CESM is housed and managed at NCAR, it is an open source climate model, involving scientists across the nation and around the world in making contributions and improvements.

Thanks in part to BER support, CESM and the nation’s other climate models are becoming more realistic, incorporating more precise and complex natural and human processes that are shaping the global climate. For example, the Climate Science for Sustainable Energy Future program, a joint effort between NCAR and DOE’s Lawrence Berkeley Laboratory, is embedding the socioeconomic and energy technology components of integrated assessment models into the CESM model in order to better understand how the planting of biofuel crops will affect the atmosphere, soil, water, and agriculture. These new capabilities will allow the climate science community to address societally-relevant questions in a way that has not been possible in the past.

New in FY 2012, BER-supported scientists will study methods to rapidly integrate new sub-models, datasets, and other model components into global Earth system models. Another focus will be enabling Earth system models to effectively use future computer architectures, such as the new IBM Blue Gene/Q being commissioned at Argonne National Laboratory. BER scientists will also expand arctic climate research activities and develop new observation capabilities for clouds, aerosols, and the terrestrial carbon cycle in this globally important and climatically sensitive region. A new Atmospheric Radiation Measurement Climate Research Facility site to be developed in the Azores will provide critical long-term observations for marine clouds and aerosols. Such new research efforts strengthen existing BER atmospheric process studies and modeling and are critical for the advancement of this scientific field.

**In order to develop more accurate, increasingly realistic, and higher resolution Earth system models, with better environmental predictive capabilities for businesses and communities, I urge you to fund the Office of Biological and Environmental Research (BER) within the DOE Office of Science at the requested $717.9 million for FY 2012.**

**Advanced Scientific Computing Research**

Also within DOE Science, Advanced Scientific Computing Research (ASCR) delivers leading edge computational and networking capabilities to scientists nationwide, enabling advances in computer science and the development of specialized software tools necessary to answer major scientific questions being addressed by the Office of Science and the larger university community.

ASCR’s continued progress is of particular importance to atmospheric scientists involved with Earth system model development. Representing the complex processes and interactions of the Earth’s systems, while efficiently harnessing the enormous amount of computing power necessary, requires very advanced software engineering, computer science, and numerical
techniques. Because the climate simulations using the CESM (described above) are too computationally intensive to be run at NCAR alone, they are outsourced to the DOE’s Leadership Computing Facilities. At Oak Ridge National Laboratory (OLCF), a new 2.33 petaflop system is available to the scientific community, and Argonne National Laboratory (ALCF) has proposed building a 10 petaflop IBM Blue Gene/Q supercomputer next year. The FY 2012 request supports continued operations of existing supercomputing systems as well as the new ALCF 10 petaflop system.

DOE’s computing capacity is essential to the country. Each major upgrade unlocks reams of new detail and data on the characteristics of our current and future Earth system. A failure to maintain and continue to upgrade these Leadership Computing Facilities would seriously undermine the steady progress of the scientific enterprise in this area.

The results of this research and other research like it are brought to the broader scientific community through the Scientific Discovery through Advanced Computing (SciDAC) program. SciDAC facilitates the transfer of basic research into computational science applications through direct partnerships between applied mathematicians and computer scientists.

I urge you to fund the Advanced Scientific Computing Research (ASCR) within the DOE Office of Science at the President’s full FY 2012 budget request of $465.6 million.

Workforce Development for Teachers and Scientists

The DOE Office of Science’s education programs, such as the Workforce Development for Teachers and Scientists (WDTS) Program, are essential to maintaining U.S. leadership in science, technology, engineering, and mathematics (STEM). WDTS supports, educates, and trains the nation’s STEM workforce and facilitates the development of the knowledge and expertise that will prepare us to address future energy and environmental challenges.

WDTS has launched the DOE Office of Science Graduate Fellowship Program to support U.S. graduate students pursuing degrees in areas of basic science and engineering. The goal of the program is to encourage talented students to pursue research-focused graduate studies in physics, chemistry, biology, mathematics, computer science, engineering, and environmental science.

Programs like WDTS have produced tens of thousands of leading scientists, engineers, and technicians who have dedicated their careers to working on the great challenges of the day, including climate change, while pursuing answers to many of the most important scientific questions in physics, chemistry, biology, environmental and atmospheric science, and other areas of basic science. Their work will be critical to our nation’s continued leadership in the 21st Century.

I urge you to fund the Workforce Development for Teachers and Scientists (WDTS) program within the DOE Office of Science at the President’s full FY 2012 budget request of $35.6 million.
Renewable Energy R&D

Federal investment in the scientific research and technology development involved with renewable energy is one of the most important investments we can make in our nation’s future and our ability to build resilience to economic and environmental challenges. Renewable energy conveys numerous cross-cutting benefits to society, including reducing our dependence on foreign oil, driving innovation in the energy economy, decentralizing the energy market, providing new high-tech jobs, reducing the human toll on the environment, and improving air quality and public health outcomes.

Our national research universities, along with DOE laboratories and an emerging private sector, are driving the country’s growth in renewable energy and increasing the efficiency of new technologies. One example of such collaboration includes an expanding NCAR partnership with DOE’s National Renewable Energy Laboratory (NREL) and the regional utility company, Xcel Energy, to develop sophisticated wind energy forecasts for operational use. These provide critical information to select the most productive locations for new wind turbine farms, better integrate wind-generated electricity into the power grid, and make critical decisions about powering down traditional coal- and natural gas-fired plants when sufficient winds are predicted. To reduce the costs of integrating wind and solar energy into the electrical grid and to make renewable energy more cost effective, significant improvements in weather forecasting technologies are required and additional weather observations are needed in the lower atmosphere.

Given the critical importance to the nation of developing economically and environmentally sustainable technologies for producing energy, I urge the Subcommittee to fully fund the FY 2012 budget request of $3.2 billion for the Office of Energy Efficiency and Renewable Energy.

I want to thank the Members of the Subcommittee in advance for supporting, through the Department of Energy, basic and cutting-edge scientific research and for promoting education and workforce development in the environmental and other Earth sciences. By doing so, you are advancing the nation’s economic recovery and sustaining our global scientific leadership.