Statement of

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Chairman Bingaman, Ranking Member Murkowski, Members of the Committee, thank you for the opportunity to testify today.

For the past several months, Congress has considered various energy bills, including comprehensive energy and climate legislation. As part of that process, industries and groups have spoken up to promote and defend their interests. I am concerned, however, that an important part of this discussion has been missing. I am concerned that we have not adequately focused on the importance of research and development of new energy technologies. Today, I am here to speak up for clean energy R&D.

Investment in energy R&D will drive innovation across the economy and maintain American competitiveness. It will create jobs and entire new industries. And it is vital for meeting the energy and climate challenge. We have many technologies in hand today to begin a transition to a low-carbon economy, and we are accelerating that work through the Recovery Act. But, over the long-term, we will need breakthroughs and better technologies to make the steep reductions in greenhouse gas emissions we need.

The economics of R&D investments have been well-studied, beginning with the Nobel Prize-winning work of Robert Solow. Dr. Solow showed that increases in productivity were ultimately due to technology development and that this development occurs through the acquisition and application of knowledge.

Several years ago, I was a member of the committee that produced the National Academies Report "Rising Above the Gathering Storm." As our report stated: "Since Solow's pioneering work, the economic value of investing in science and technology has been thoroughly investigated. Published estimates of return on investment for publically funded R&D range from 20 to 67%." Let me stress that we were talking about an annual rate of return on investments.

What has been the return on investments in the DOE been in the past? There was a 2001 study by the National Academies of Science entitled "Energy Research at DOE: Was It Worth It?" The study looked at the impact of $22.3 billion in investments in energy efficiency and fossil energy research from 1978 to 2000 by investigating in detail

the impacts of few specific technologies supported by these investments. It found that, while most of the cases studied did not yield significant benefits within the timeframe of the study, a few of the investments in energy efficiency were stunningly effective – just what you would expect from an R&D program. In particular, an investment of $12 million in a few key energy efficiency technologies – advanced refrigerator and freezer compressors, electronic ballasts for fluorescent lamps, and low-emissivity glass – helped lead to $30 billion in benefits for the American people.

Let me give you another recent example of the benefits of DOE's research efforts. The Department was an early funder of the A123Systems battery company. In 2001 and 2003, A123 received Small Business Innovation Research grants totaling $850,000 to test and refine its cutting-edge lithium-ion battery technology. Since then, A123 has raised more than $100 million in private capital, and its customers now include several automakers working on hybrid and electric vehicles. In 2009, A123 went public in the biggest IPO of the year.

And this success story does not end there. Today, 98 percent of the batteries that power America's hybrid cars are made in Asia. But, thanks in part to a Recovery Act grant, A123 is now building a new plant in Michigan that will increase the company's battery manufacturing capacity to a level that can supply 24,000 plug-in hybrid electric vehicles with 15kwh battery systems per year. This will create or save roughly 5,400 jobs nationwide, while giving the U.S. a foothold in a key growth industry.

It is imperative that government provide R&D funding, especially at the front end when private investments would not recoup the full value of the shared social good or when a new technology would displace an embedded way of doing business. As the National Economic Council recently stated: "certain fundamental investments and regulations are necessary to promote the social good. This is particularly true in the case of investments for research and development, where knowledge spillovers and other externalities ensure that the private sector will under-invest – especially in the most basic of research." Federal R&D investment also builds the human, physical, and technological capital needed to perform breakthrough research and to transfer those innovations to the market.

The Administration understands the urgent need for more scientific research and plans to double the federal investment in key R&D agencies. Additionally, the Recovery Act gave the Department of Energy significant new research funding.

With our precious research dollars, the Department of Energy is seeking breakthroughs such as the following:

- Gasoline and diesel-like biofuels generated from lumber waste, crop wastes, solid waste, and non-food crops;
- Automobile batteries with three times today's energy density that can survive 15 years of deep discharges;

- Photovoltaic solar power with a fully installed cost four times cheaper than today's technology;
- Computer design tools for commercial and residential buildings that enable reductions in energy consumption of up to 80 percent with investments that will pay for themselves in less than 10 years; and
- Large scale energy storage systems so that variable renewable energy sources such as wind or solar power can become base-load power generators.

In addition to our base programs, the Department has launched a broad research strategy that begins by drawing upon the incredible resources of our National Laboratories. With the help of Congress and this Committee, the Department is also pursuing three new, complementary approaches to marshal the nation's brightest minds to accelerate energy breakthroughs.

The first approach is the **Energy Frontier Research Centers**, which are multi-year, multi-investigator scientific collaborations focused on overcoming known hurdles in basic science.

The second approach is the **Advanced Research Projects Agency-Energy (ARPA-E)**. ARPA-E uses a highly entrepreneurial funding model to explore potentially transformative technologies that are too risky for industry to fund. We have already funded several extremely exciting projects, including a liquid metal battery that could provide grid-scale energy storage, a new wind turbine that can achieve higher efficiencies with a smaller size, and a new approach to carbon capture inspired by an enzyme used by the human body to capture and transport carbon dioxide generated in our cells during metabolism to the lungs where it is exhaled.

The third novel funding approach, **Energy Innovation Hubs**, will establish larger, highly integrated teams working to solve priority technology challenges. This work spans from basic research to engineering development so that the ideas can be quickly commercialized. With this more proactive approach to managing research, we are taking a page from America's great industrial laboratories in their heyday. Their achievements – from the transistor to the information theory that makes modern telecommunications possible – are evidence that we can build creative, highly-integrated research teams that can accomplish more, faster, than researchers working separately.

The Hubs will tackle three of the most important energy challenges we face: How can we derive fuels directly from sunlight in an efficient and economical way? How can we design, construct and retrofit commercial and residential buildings that are vastly more energy efficient than today's buildings? How can we use modeling and simulation technologies to make significant leaps forward in nuclear reactor design and engineering? The Hubs are expected to begin work in 2010 and will be fully operational by 2011.

I am extremely excited about these programs, as well as the Department's other research and development efforts. Today, the Department of Energy has assembled, and continues to recruit, a team of extraordinary talented individuals with technical depth and

breadth. The shared camaraderie of this team is also beginning to break down decades of stove-piped thinking.

We are changing the way we do business at the DOE to improve customer responsiveness and the quality of our selection of competitive grants. As an example, in order to identify the best possible reviewers for the first round of ARPA-E proposals, I wrote a letter to many of the Presidents of our research universities to ask for the names of their best scientists and engineers. We then called upon those people to help review the proposals, arguing that they should help us as part of their patriotic duty. The technical community responded heroically and we were able to review 3,700 applications, conducting over 4.2 person years of work, in a few short weeks. That fact that we could only fund 1 percent of the applications speaks volumes that additional research support would be money well spent.

To achieve our energy and climate goals, we need a strong and sustained commitment to research and development. These investments are needed for our country's future economic prosperity, energy security, and environmental sustainability. I can assure you that I will do everything in my power to ensure that the Department of Energy will use these resources wisely.

I urge this committee and the Senate to look closely at this issue in the coming months, and I look forward to working with you on it. I'm pleased to take any questions at this time.