Statement of Patricia A. Hoffman
Deputy Director of R&D and Acting Chief Operating Officer
Office of Electricity Delivery & Energy Reliability
Department of Energy

Committee on Energy and Natural Resources
United States Senate
November 6, 2007

Mr. Chairman and Members of the Committee, thank you for this opportunity to testify on behalf of the Department of Energy (DOE) on the nation's domestic energy sector workforce.

Our nation's technical workforce is the backbone of our economy. These individuals have accumulated a wealth of experience and knowledge that cannot be duplicated overnight. If America is to remain the world's leader in science and technology and continue to lead the world in energy innovation, the energy industry needs to invest in a vibrant workforce.

Given looming retirements in the energy workforce, success in ensuring America's future energy security will depend on our ability to recruit, educate, and train highly skilled workers to meet the demands of our rapidly evolving, technology-driven energy industries. As traditional sources of energy become more stretched by the growing demand for energy domestically and globally, our nation's energy sector will undergo significant changes. Energy security is undeniably linked to our national interest. The move to diversify our energy supply from the conventional sources of the past requires equipping our workforce with the skills, technology, and creativity required to achieve a sustainable energy future.

Electric Sector

In 2006, DOE released a report to Congress on "Workforce Trends in the Electric Utility Industry," pursuant to section 1101 of the Energy Policy Act of 2005 (EPACT). The

report examined workforce trends associated with the electricity delivery industry, which is the primary focus of my office, OE. For electric utilities, whose service quality and reliability depend on maintaining an adequate, knowledgeable workforce, managing the upcoming retirement transition is a particular challenge.

Although the report did not forecast an immediate threat to the reliability of the electric system, it raises awareness of the need to plan for and proactively address this workforce transition. For the purposes of this analysis, trends associated with electrical lineworkers and electric power engineers were considered representative of the broader electric utility workforce. Electrical lineworkers' responsibilities include erecting poles and light or heavy-duty transmission towers and installing or repairing cables or wires used to carry electricity from the power plant to the customer; they represent the physical labor required to operate and maintain the electric grid. Electric power engineers traditionally focus on systems and devices for the conversion, delivery, and use of electrical energy. These applications enable technology enhancements that significantly improve the capability, performance, and reliability of the entire electricity system.

Electric Lineworkers

Since 2000, the electric utility industry's employment level for lineworkers, which experienced declines from the early 1990s into the early 2000s that coincided with restructuring of the industry, has been steadily increasing. This hiring trend is driven by utilities' anticipation of increased demand, and is a response to the long periods of little or no capital investment. Utilities, concerned at the prospect of meeting rising demand for electricity using the existing transmission lines, have embarked upon a hiring program to provide the employees necessary to maintain, upgrade, and expand the electric utility system. The August 2003 U.S.-Canada blackout also focused attention on the fragile state of the grid, which put pressure on utilities to ensure that they were meeting reliability standards.

Growth in the industry is outpacing the number of available and qualified personnel. In 2005, there were approximately 31 lineworker-training programs across the country, with

a total of 1,360 active students in various stages of lineworker training. Should the present trend continue, the number of pre-apprenticeship lineworker training institutions across the country could increase to 45 institutions by the year 2015. Yet, even with the increased interest of students in entering these training programs, the numbers may still not be enough to compensate for the expected retirements. Across the organizations contacted for the section 1101 report, retirement eligibility and the percentage of the workforce expected to retire within the next five to ten years varies from about 11 percent to as high as 50 percent. One utility indicated that the high level of retirements that began a few years ago is expected to persist for the foreseeable future due to this demographic profile, which includes a very high percentage of the lineworker and engineering workforce.

The electric industry is being proactive in addressing the lineworker shortage by building awareness, encouraging training initiatives, and increasing interest in the lineworker profession at an early age. It is important to note, however, that the magnitude of the impact on individual utilities varies significantly. Even with the addition of new lineworkers to the labor pool, the loss of historical knowledge (and perhaps productivity due to the more inexperienced workforce) might by itself have a detrimental effect on the reliability and security of the grid.

Adequate training is the key to sustaining a qualified pool of lineworkers. Preparing a highly skilled electric utility lineworker can require 10 to 12 years, including classroom instruction and on-the-job experience. Potential lineworkers pass through various stages of career development, from “Introductory Training” to formal apprenticeship programs to on-the-job learning. Since the attrition rate is very high for new lineworkers, these courses help orient trainees to the mindset needed for lineworker careers before utilities make a large investment in the employee’s career development. In many cases, however, utilities will bring trainees directly into their apprenticeship programs without the student having completed an introductory training program.

Strong public-private partnerships are necessary to promote the energy industry as a viable employment option, to develop strategies for encouraging retirement-eligible workers to remain employed in the industry, and to ensure adequate training and education opportunities. Developing and using technology to increase productivity and fostering knowledge transfer may also be beneficial.

One example of a successful public-private partnership, although geared toward operator training and not lineworkers, is the Department's designation of Bismarck State College in North Dakota as a National Power Plant Operations Technology and Educational Center. Bismarck State's programs in power plant, process plant, electric power, electrical transmission systems, and nuclear power technologies will educate and train many of our future energy sector workers. It also uses the latest technologies via the internet and training simulations to speed up the knowledge transfer process.

Electric Power and Transmission Engineers

Jobs for new power engineering graduates began declining in the 1980s when utilities saw a decline in electric consumption, and the job market remained challenging with deregulation in the 1990s. However, by 2001 and 2002, power engineering graduates were able to find positions at generation companies, transmission companies, power traders, independent system operators, independent power producers, consulting companies, and large processing and manufacturing companies that have extensive electrical facilities.

As detailed in the section 1101 report, the projected demand for power engineers will grow to 11,113 by 2014, which represents an 8.1 percent increase. The average annual demand for electrical engineers in the electric utility industry is 749 per year for the 10 year period from 2004 to 2014. International competition and the use of engineering services performed in other countries may limit employment growth domestically; nevertheless, the projected strong demand for electrical devices such as giant electric power generators could provide employment opportunities in the U.S.

Over the past decades, there has been a decline in the United States in the number of students considering power engineering careers. In contrast, in many countries outside of the United States, the power engineering profession enjoys more prestige and thus, experiences higher enrollment levels. There are indications that the power engineering education system in the United States is actually weakening, and the rate of weakening will likely escalate as faculty retirements occur without replacement. Without strong support for strategic research and without qualified replacements for retiring faculty, the strength of the university-based power engineering education programs will continue to decline. This is in part because some schools do not rehire power faculty and instead use the faculty slots to hire individuals with other technical knowledge.

DOE supports Gonzaga University in Spokane, Washington in developing an online certificate program in transmission and distribution engineering aimed at practicing utility engineers who seek to broaden and upgrade their skills. In addition to basic electric design, construction, operation, and maintenance courses, this program also plans to offer courses in related disciplines that would examine the environmental and legal aspects of electric line design, which have become inherent components of modernizing the grid. The availability of this course online minimizes the disruption to the engineer's work schedule and reduces the employer's cost for the training.

Renewable Energy Sector

The Administration, through efforts such as the *Advanced Energy Initiative*, supports new, bold steps toward the goal of a reliable, affordable, and clean energy future for all Americans. In the energy sector, the enhanced use of renewable electricity generation – from such sources as solar photovoltaics, high-efficiency wind power, and biomass – would help reduce emissions of air pollutants and greenhouse gases. It is clear that continued innovation is an important part of unlocking our energy future.

The Department has conducted surveys of key market participants to better understand the time required for training qualified photovoltaic (PV) installers. These surveys

indicate that the time to train a qualified PV installer ranges from 6 weeks to 3 months if the trainee already has basic training in a key “enabling" trade, for example, as an electrician or roofer.

DOE also estimates there may be additional workforce needs in the buildings sector, including trained trades and trades management (electrical, plumbing, HVAC techs, etc.); mid-level construction managers and building operators/energy managers; skilled professionals (lighting designers, building commissioners, energy auditors, construction specifiers/purchasing agents, etc); and building professionals (architects, engineers, designers, etc.). DOE is working with a consortium of universities to develop multi-level, multi-disciplinary building science curricula to support the long range needs of the home building industry. The Department is also working with professional organizations like AIA, ASHRAE, IESNA, and IALD to promote the integration of efficiency technologies and practices into their professions as well as to draw upon their knowledge as we implement our programs.

Nuclear Sector

The expansion of nuclear power in the United States offers our nation the opportunity to foster continued economic growth, to raise living standards, and to be responsible stewards of the environment by reducing greenhouse gas emissions. DOE’s Nuclear Energy Research Initiative, which focuses on developing nuclear science and technology, recently announced the selection of 11 U.S. university-led grant recipient teams to receive up to $30.7 million for cooperative research projects.

White House Initiative on Historically Black Colleges and Universities

The Department also supports the White House Initiative on Historically Black Colleges and Universities (HBCUs) in developing the energy sector, which is administered through the office of the Secretary within the U.S. Department of Education. In the last

three fiscal years, the Department's National Nuclear Security Administration (NNSA) has awarded 41 grants to 25 HBCUs totaling over $47 million. The grants cover research related to the NNSA's nuclear security and nonproliferation mission requirements, curriculum development in science and technology programs, and infrastructure improvements.

DOE's Office of Economic Impact and Diversity also facilitates numerous mentor-protégé relationships. This past summer, for example, the Oak Ridge National Laboratory and Morehouse College signed the first such agreement between an HBCU and a DOE Office of Science laboratory. The new joint initiative will assist students in the college's science programs and promote research collaboration at both institutions. Many students from Historically Black Colleges and Universities have participated in the Department's internship programs. Interns from summer 2007 in our offices in Washington, DC and Germantown, Maryland, worked on projects in nuclear energy, computer technology, radioactive waste, energy efficiency, scientific research, and environmental management. An additional 40 students were assigned to DOE's national laboratories and field facilities. Finally, the Dr. Samuel P. Massie Chairs of Excellence Program, funded by DOE, is named after an African-American chemist of national reputation who was a leader in championing the cause of minority education in the United States. The program now comprises nine HBCUs that graduate more than 30 percent of the minority engineers in the United States.

Meeting Workforce Demands

The following are ways in which the federal government can address future energy workforce demands in the United States:

Foster Math and Science Education

DOE's Office of Science has long been the dominant federal sponsor of basic research in the physical sciences, including physics, chemistry, and related fields. The Office of Science also supports computer sciences, mathematics, environmental sciences, materials

research, nanotechnology, and engineering. These research programs are supported by a dedicated effort designed to recruit, train, and retain the next generation of Americans who are interested in science, technology, engineering and mathematics (STEM) careers. The Office of Science, through its Office of Workforce Development for Teachers and Scientists, currently supports more than 600 undergraduate internship experiences at DOE laboratories and 200 K-12 educators who work with master educators and mentor scientists to hone their classroom skills. The Office of Science, through its research grants, also supports the training of thousands of graduate students and post-doctoral researchers, and has several dedicated graduate fellowship programs in the physical, computer, and life sciences. The Office of Science is in the process of working with DOE offices – including OE – that could benefit from focused placements of internships and fellowships in dedicated research assignments of importance to the U.S. electric utility industry.

In addition, the Office of Science promotes science literacy and interest in the STEM careers through the National Science Bowl, which annually attracts 20,000 middle school and high school students to competitions at 100 regional events located throughout the U.S., and other efforts. One example is DOE's annual "Day of Science" at the Oak Ridge National Laboratory in Tennessee, which this year was attended by more than 1,000 students from 125 universities, including many Historically Black Colleges and Universities. Students from across the country participate in scientific presentations, innovative technology demonstrations, and one-on-one interactions with laboratory researchers. Faculty from universities also participate in this annual event and attend workshops designed to help them understand how to compete for DOE research grants and participate in DOE's research enterprise.

Support Strategic Research in Engineering

As noted earlier, university-based research and education is an engine for innovation, exploration, and ingenuity. Curricula need to strike an effective balance between addressing the short-term needs of industry and promoting the strategic research necessary to maintain America's long-term competitiveness. Without strong support for

strategic research in engineering and without qualified replacements for retiring faculty, the strength of our Nation's university-based engineering programs will wane, and along with them, the foundation for innovation in the energy sector to meet our future challenges. We need to ensure adequate funding for academic programs in energy-related disciplines to attract the most talented students to these programs.

For instance, the Department's funding of the Power Systems Engineering Research Center (PSERC), a multi-university, multidisciplinary National Science Foundation-sponsored center, develops broadly trained power engineers as well as future power engineering faculty candidates.

Promote Interest in Energy-Related Careers

There are significant opportunities for creativity and innovation in the energy sector to meet the challenges of the 21st century. It is important to highlight that supporting energy infrastructure is a national strategic priority. Federal agencies could work with the private sector to communicate what the energy industry is about, to emphasize the high-tech nature of future challenges, to identify the direction the industry is moving, and to build awareness for the careers of tomorrow.

Capture Existing Workforce Knowledge

Even as we grow our workforce, the loss of historical knowledge as the so-called baby boomer generation retires, could be detrimental to productivity. For instance, a shortfall in experienced lineworkers would create longer restoration times after a disruption. Training, workforce retention, and phased retirements could help mitigate any consequences.

Develop Cross-cutting Understanding

An analysis of the interdependencies of the workforce across the entire energy flow – from coal miners and well riggers to electrical lineworkers and engineers – is required to ensure energy reliability will not be impacted by a national shortage of skilled personnel.

The Department of Energy is partnering with the Department of Labor (DOL) to arrive at a better understanding of energy sector workforce issues. As Assistant Secretary DeRocco mentioned, the Department of Energy is working with DOL to fulfill the requirements of Sections 385 and 1830 of EPACT. As you know, those sections required DOE to enter into an arrangement with the National Academy of Sciences to conduct a study on the availability of skilled workers in the energy sector. Assistant Secretary DeRocco's testimony further describes this effort, and DOE is looking forward to working with DOL and the National Academies.

Think Globally

In the past, declines in the domestic science and engineering labor force could be compensated for by attracting the best and brightest scientists and engineers from around the world. However, with new cutting-edge research infrastructure being built overseas, and with strong employment prospects in several developing regions, there is perhaps less of an incentive for students to remain in the United States upon graduation. Statutory caps on high-skilled temporary work visas and employment-based immigration limit the number of students and professionals that are able to either enter or remain in the United States.

Conclusion

In order to maintain our economic preeminence in an increasingly competitive world, U.S. industry *must* invest in its human capital to ensure the next generation of skilled personnel, scientists, and engineers capable of maintaining American leadership in critical science and technology areas as we work to meet the energy and economic challenges of the 21st century.

This concludes my statement, Mr. Chairman. I look forward to answering any questions you and your colleagues may have.