House Science Committee Discusses Nuclear Waste Recycling Risks and Benefits, and Status of R&D

The Committee on Science and Technology within the U.S House of Representatives held a hearing on June 17 to explore the status of nuclear waste recycling and to discuss ongoing and needed research, development, and demonstration activities in the federal government, private sector, and around the globe. Committee members and witnesses also discussed the safety, environmental, security, and economic issues related to the adoption of a nuclear waste reprocessing strategy.

"I believe everything has to be on the table when it comes to meeting our growing need for energy and reducing greenhouse gas emissions," said Committee Chair Bart Gordon (D-Tenn.). "I believe nuclear power is part of the solution to the daunting challenge of climate change, and I also recognize that our 104 operating reactors provide very reliable baseload power. To me, the best reason to consider reprocessing is that an expansion of nuclear power may make the once-through fuel cycle inadequate for maintaining our nuclear power supply as uranium resources eventually become scarce."

The United States currently has 104 commercial nuclear power reactors licensed to operate in 31 states, which provide about 20% of the country's electricity supply. Nuclear energy provides a reliable baseload of electrical power, without the greenhouse gas emissions associated with other sources of electricity, such as fossil fuels. According to the Committee, many experts believe it would be difficult, if not impossible, to meet the country's growing need for energy while reducing greenhouse gas emissions without using nuclear energy.

According to the Committee, one of the main drawbacks of nuclear energy is the creation of nuclear waste. The approximate 58,000 metric tons of spent nuclear fuel already existing at these reactor sites continues to accumulate at a rate of 2,000 metric tons per year. Generally, the United States has pursued a policy to store nuclear waste in a geologic repository while supporting some R&D on recycling technologies.

U.S. nuclear waste policy since the 1970s has been that nuclear fuel is used once in a reactor and then permanently disposed of in long-term storage. Congress designated Yucca Mountain in Nevada as the sole candidate site for a permanent high-level nuclear waste repository in 1987; however, the target date to start loading waste into the repository has been pushed back repeatedly, from 1998 as the first target date. The president's 2010 budget request appears to continue the Yucca Mountain licensing process, but it includes a significant funding cut that would delay the current planned 2020 opening of the repository, according to the Committee. The president is also convening a blue ribbon panel to look for alternative solutions for managing the country's nuclear waste. The waste is currently being safely stored at reactor sites around the country.

Only a small portion of the energy potential in nuclear fuel is used during the creation of nuclear power. In recycling, the spent fuel is processed to separate waste materials so that the fissionable uranium and plutonium can be recycled into new fuel, the so-called "closed" fuel cycle.

The benefit of the closed fuel cycle is that it would reuse spent fuel, allowing producers to extract more energy from the given supply of natural uranium, which could become scarce if there is large expansion of nuclear power. It could also potentially save space in an underground repository, though it would not completely eliminate the need for long-term isolation of nuclear waste from the environment.

The downside is that, with existing technology, the closed fuel cycle is generally considered to be substantially more expensive than the once-through cycle. Reprocessing also raises concerns about the proliferation of weapons-grade nuclear materials.

"There are near-term technologies available for reprocessing spent nuclear fuel that could be deployed in the United States relatively quickly, but there are some well-documented concerns raised about this strategy," said Gordon. "I am also aware of ongoing research in more advanced technologies that could address the nuclear fuel cycle issues we face today."

The Committee and witnesses discussed the need for a more robust long-term research and development program, including an R&D road map, to address outstanding issues and to clarify the best role for both the federal government and the private sector.

R&D could lead to new technologies such as advanced reactors that would allow recycling of used fuel multiple times. Depending on the technology chosen, fast reactors could create new fuel from spent fuel in a manner that would allow it to utilize nearly all of the spent fuel's fissionable constituents. Heat is the main limiting factor for a repository's capacity and fast reactors could destroy some of the longest lived heat producing transuranics from the fuel. Reducing these constituents in the waste and reducing long-term heat generation could provide significant disposal benefits, according to the Committee.

NRC Releases Report on Women and Hiring and Tenure Processes for Science and Engineering at Research Universities

Although women are still underrepresented in the applicant pool for faculty positions in math, science, and engineering at major U.S. research universities, those who do apply are interviewed and hired at rates equal to or higher than those for men, according to the new report from the National Research Council, *Gender Differences at Critical Transitions in the Careers of Science, Engineering, and Mathematics Faculty*. Similarly, women are underrepresented among those considered for tenure, but those who are considered receive tenure at the same or higher rates than men.

The congressionally mandated report examines how women at research-intensive universities fare compared with men at key transition points in their careers. Two national surveys were commissioned to help address the issue. The report's conclusions are based on the findings of these surveys of tenure-track and tenured faculty in six disciplines—biology, chemistry, mathematics, civil engineering, electrical engineering, and physics—at 89 institutions in 2004 and 2005. The study committee also heard testimony and examined data from federal agencies, professional societies, individual university studies, and academic articles.

In each of the six disciplines, women who applied for tenure-track positions had a better chance of being interviewed and receiving job offers than male applicants had. For example, women made up 20% of applicants for positions in mathematics but accounted for 28% of those interviewed, and received 32% of the job offers. This was also true for tenured positions, with the exception of those in biology.

However, women are not applying for tenure-track jobs at research-intensive universities at the same rate that they are earning PhD degrees, the report said. The gap is most pronounced in disciplines with larger fractions of women receiving PhD degrees; for example, while women received 45% of the PhD degrees in biology awarded by research-intensive universities from 1999 to 2003, they accounted for only 26% of applicants to tenure-track positions at those schools. Research is needed to investigate why more women are not applying for these jobs, the committee said.

"Our data suggest that, on average, institutions have become more effective in using the means under their direct control to promote faculty diversity, including hiring and promoting women and providing resources," said committee co-chair Claude Canizares, Bruno Rossi Professor of Physics and vice president for research at the Massachusetts Institute of Technology. "Nevertheless, we also find evidence for stubborn and persistent underrepresentation of women at all faculty ranks."

The surveys revealed that most institutional strategies to try to increase the proportion of women in the applicant pool—such as targeted advertising and recruiting at conferences—did not show significant effectiveness, the report said. One strategy did appear to make a difference: Having a female chair of the search committee and having a high number of women on the committee were associated with a higher number of women in the applicant pool.

The report also assessed gender differences in the following areas:

- Access to institutional resources: Men and women reported comparable access to many institutional resources, including start-up packages, travel funds, and supervision of similar numbers of postdoctorates and research assistants. And in general, men and women spent similar proportions of their time on teaching, research, and service. Although at first glance men seemed to have more laboratory space than women, this difference disappeared when other factors such as discipline and faculty rank were accounted for. However, men appeared to have greater access to equipment needed for research and to clerical support, the report said.
- Tenure: In every field, women were underrepresented among candidates for tenure relative to the number of female assistant professors. In chemistry, for example, women made up 22% of assistant professors, but only 15% of the faculty being considered for tenure. Women also spent significantly longer time as assistant professors. However, women who did come up for tenure review were at least as likely as men to receive tenure.
- Salary: Women full professors were paid on average 8% less than their male counterparts, the report said. This difference in salary did not exist in the ranks of associate and assistant professors.
- Climate and interaction with colleagues: Female faculty reported that they were less likely than men to engage in conversation with their colleagues on many professional topics, including research, salary, and benefits. This distance may prevent women from accessing important information and may make them feel less included and more marginalized in their professional lives, the committee said. While on average institutions have done more to address aspects of career transitions under their control, the report said, one of the remaining challenges may be in the climate at the departmental level.
- Outcomes: On most key measures—grant funding, nominations for awards and honors, and offers of positions at other institutions—there is little evidence of differences in outcomes. In terms of funding for research, male faculty had significantly more funding than female faculty in biology; in other disciplines, the differences were not significant.

The committee urged further research on unanswered questions, such as why more women are not applying for tenure-track positions, why female faculty continue to experience a sense of isolation, and how nonacademic issues affect women's and men's career choices at critical junctures.

"Overall the newly released data indicate important progress, and signal to both young men and especially to young women that what had been the status quo at research-intensive universities is changing," said committee co-chair Sally Shaywitz, Audrey G. Ratner Professor in Learning Development and co-director of the Yale Center for Dyslexia and Creativity, Yale University School of Medicine. "There is a movement toward more gender equity than noted in previous reports or often publicly appreciated. At the same time, the findings show that we are not there yet. The gap between female graduates and the pool of female applicants is very real, and suggests that focus next be placed on examining challenges such as family and child responsibilities, which typically impact women more than men."

The report is available on the Academies Web site, www.nap.edu.

India Ushers in New Science Minister

Following elections in May, Prithviraj Chavan became India's Minister of Science & Technology (DST) and Minister of Earth Sciences. A graduate with honors in mechanical engineering from Birla Institute of Technology, Pilani, the new Science Minister also holds a Masters degree in engineering from the University of California at Berkeley. Also a member of the Indian Atomic Energy Commission and the Space Commission, the Minister said he was looking forward to all scientific departments working together.

On his first day in office at the Council of Scientific & Industrial Research (CSIR), Chavan held a meeting with the heads of departments and other key officials of the two Ministries. The team of scientists headed by Secretary DST, T. Ramasami and DG CSIR, Samir Brahmachari, apprised the Minister of ongoing projects in various S&T areas.

At the end of May, the Cabinet Committee on Economic Affairs approved the expansion of the CSIR-managed New Millennium Indian Technology Leadership Initiative (NMITLI) program. The program will now experiment with new ways of conducting research and development (R&D) in a Public-Private-Partnership (PPP) mode for greater innovation. The program was originally announced as part of the Union Budget in the year 2000. NMITLI has so far evolved 57 largely networked projects in diverse areas, including energy and materials.

NMITLI will now fund R&D projects along with industry on an equal sharing basis; co-finance projects with Venture Capital Funds; set up innovation centers in selected research areas for long-term, sustained efforts; and support post-NMITLI projects. Among the selected topics for innovation centers are photovoltaics, fuel cells, white light-emitting diodes, and medical implants.

Many government departments engaged in R&D activities experience a considerable degree of overlap. Part of the NMITLI funds will be utilized to generate inter-departmental projects. □