

US Nanotech Program Strong, but International Race Is On

After five years of research and more than \$4 billion in federal spending, the National Nanotechnology Initiative (NNI) has given the US the global lead in the emerging field of nanoscience, but other countries are “aggressively chasing” US leadership with both broad and focused research programs. That assessment is from the President’s Council of Advisors on Science and Technology (PCAST) in the first in-depth review of the government’s effort to coordinate the many research disciplines and federal agencies involved in nanotechnology.

Annual federal spending on nanotechnology is about \$1 billion, with more than 20 different agencies receiving NNI money, according to the PCAST report. That \$1 billion represents about one-quarter of the current nanotechnology spending by governments in all nations.

When state and private nanotechnology spending are added to the federal number, total US R&D spending stands at \$3 billion annually, one-third of the global spending of about \$9 billion. “Nanotechnology today reminds me very much of the early days of the semiconductor industry,” E. Floyd Kvamme, cochair of PCAST and a founder of National Semiconductor in the 1960s, told the House science subcommittee on research in June. “The new interdisciplinary relationships being forged and the sense of excitement over future possibilities are very reminiscent of that earlier period.”

In his testimony and as lead author of the report, Kvamme was low-key about threats to US leadership in nanotechnology, calling the report’s two central concerns—growing international competition and problems with an inadequate technology workforce in the US—“cautionary notes and minor recommendations.” Others testifying at congressional nanotechnology hearings were not so sanguine.

“The relative lead [in nanotechnology] the US currently holds is in jeopardy because the rest of the world is catching up in a variety of measurements,” said Jim O’Connor, a vice president at Motorola Inc. Testifying before the science subcommittee, O’Connor said, “In government funding, for example, the rate of increase in the European Union and Asia is higher than that of the US. This should be a wake-up call for American

researchers and policymakers alike.”

He noted that China has more than twice as many engineers working in nanotechnology as the US has, and that countries spending less than the US are focusing their research to try to gain the lead in one or two fields. “Korea and Taiwan are investing heavily in nanoelectronics,” he said, “while Singapore and China are focusing on nanobiotechnology and nanomaterials, respectively.”

The “Where do we stand?” section of the PCAST report says, “Virtually every country that supports scientific and technology R&D has a nanotechnology initiative.” The “vast investments” by governments and private industry have spurred scientific progress, the report says, “yet most agree that nanotechnology is, by and large, still in a nascent stage and that its ultimate impact on the world economy remains to be seen. What all agree upon is that significant potential clearly exists.”

Regional, state, and local government spending in the US, often overlooked in nanotechnology studies, totaled more than \$400 million in 2004, the report says. State and local education and training programs are also playing a role in developing a technically skilled workforce. Some of the training is done through partnerships with universities or federal nanotechnology centers, and some is done through new state programs that provide “nanotechnology-relevant curriculum assistance to community colleges.”

The report, citing a recent study by Lux Research Inc, said that of the \$8.6 billion spent on nanotechnology R&D worldwide in 2004, \$3.8 billion was by corporations. Of that, 46%, or \$1.7 billion, was by North American (predominantly US) companies; 36%, or \$1.4 billion, was by Asian companies; 17%, or \$650 million, was by European firms; and about 1%, or \$40 million, was by businesses in other regions. Venture capital companies investing in nanotech startup companies spent another \$400 million worldwide.

In looking at peer-reviewed scientific articles on nanotechnology, the report found that although the US still leads in publications, its share has declined from 40% in the early 1990s to less than 30% in 2004. The total number of nanotechnology papers published in *Science*, *Nature*, and *Physical Review Letters* has doubled

since 1991, with US researchers responsible for more than 50% of the papers in those journals. The US percentage is beginning to decline, the PCAST report notes.

The PCAST recommendations for NNI primarily involve improving interactions with industry and with state nanotechnology programs. The report also urges the government to be “proactive” in ensuring that the environmental, health, and safety concerns of nanotechnology are addressed (see *PHYSICS TODAY*, June 2004, page 30). Finally, to make sure that nanotechnology becomes more than a “research project,” the PCAST report recommends that NNI officials work more closely with the Departments of Education and Labor to improve technical education programs related to nanotechnology.

Jim Dawson

NIF Threatened with Closure

After battling technical challenges and cost overruns, the \$3.5 billion National Ignition Facility (NIF) at Lawrence Livermore National Laboratory in California is 80% complete. Three recent independent reviews of the US Department of Energy (DOE) facility say it is well managed and on schedule to meet a 2010 deadline to attempt fusion ignition. But political maneuverings in the Senate threaten to shut down the project.

On 30 June, in a late-night showdown, Senator Pete Domenici (R-NM), chair of the Water and Energy Appropriations Subcommittee, succeeded in cutting \$224 million from the \$337 million fiscal-year 2006 budget request for NIF. The proposed cut would cancel construction work on the project, on which \$2.8 billion has already been spent. Moreover, \$50 million is included in the proposed budget to close out NIF.

Matt Letourneau, Domenici’s



NIF technicians may soon be out of a job.

spokesperson, insists that “the senator wants to see what scientific experiments can be carried out at NIF. . . . The intention is not to kill it. And it is certainly not the case that the senator is being provincial.” But in the budget Domenici added more than \$33 million for fusion-related activities, the majority of which went to research for the New Mexico-based Z machine at Sandia National Laboratories.

As planned, the finished NIF would be the world’s most powerful laser facility. By firing 192 laser beams simultaneously into a small pellet target containing tritium and deuterium, NIF would re-create the conditions inside a nuclear explosion or the Sun (see PHYSICS TODAY, April 2005, page 22). The project is a key component of the US Stockpile Stewardship program, which monitors the reliability of nuclear warheads without testing them. Recent experiments at NIF with the first four lasers have already tested the warhead simulation codes in regimes that were previously inaccessible.

The uncertainty is hurting morale at NIF. Last year, 300 researchers were laid off after Congress cut the 2005 construction budget by \$25 million. A recent DOE report hints that retaining staff is becoming a problem. “The funding provided in the Senate appropriation would require that the NIF project be shut down and abandoned in place, without the ability to operate even the four completed laser beams,” says Edward Moses, NIF’s acting associate director. “Significant employment reductions would result in the loss of NIF’s critical skills and knowledge base that are the product of 40 years of work in this field,” he adds.

The proposed cuts are also at odds with the stated goals of both the Bush administration and Representative David Hobson (R-OH), who sponsored HR 2419, the House version of the proposed FY 2006 water and energy budget. But Domenici says that NIF is taking up too much of the National Nuclear Security Administration’s budget, which is scheduled to shrink by \$3 billion over the next five years. “NIF construction cannot come at the expense of all the other stewardship programs,” he says. “NIF is just one of many tools that must be supported.” During the summer, members of the House and Senate, led by Hobson and Domenici, will try to achieve a compromise on the spending bill.

Paul Guinnessy

Women Unite to Improve Physics Culture

Taking stock after the Second International Conference on Women in Physics, held this past May in Rio de Janeiro, participants say that—as with the first such meeting, which took place about three years earlier in Paris—they came away energized.

Among the changes stemming at least in part from the Paris meeting (see PHYSICS TODAY, May 2002, page 24) are the creation of women-in-physics subcommittees in the Albanian and Japanese physical societies, studies of the climate for women in physics in both the UK and Canada, and science camps for grade-school girls in Senegal and Ghana. About 145 people, 7% of them men, from 42 countries attended the meeting in Rio de Janeiro, down from 300 people from 65 countries in Paris, a drop due largely to strained budgets.

Meeting attendees unanimously passed a resolution intended to promote the recruitment, retention, and advancement of women of all races and nationalities in physics. The resolution will be considered for endorsement this fall by the International Union of Pure and Applied Physics (IUPAP), which sponsored the conference.

Still in draft form, the resolution’s six recommendations call for IUPAP to require its liaison committees in the various member countries to

catalyze women’s participation in physics; encourage physical societies to share resources with isolated physicists—those, for example, living in developing countries, belonging to minority groups, or taking time off to raise children; require organizers of IUPAP-sponsored conferences to include more women; increase the presence of women among the organization’s leadership and practice institutional transparency; cosponsor development of training modules on such topics as gender and race equity in physics; and oversee an international survey in 2007 on the status of women in physics.

For women from the US, the meeting served as a “reality check to understand the barriers that women in physics in developing countries face,” says US delegation cochair Kim Budil, a Lawrence Livermore National Laboratory physicist currently at the National Nuclear Security Administration. “It’s a cultural embarrassment that in a wealthy and developed country, we still are talking about paid maternity leave. It would be nice if we could get past the infrastructure problems and work on the more thorny problems of climate and discrimination.”

“Many female scientists have difficulties seeing the problem, although it may become clearer when they get to higher positions and [have to] dispute the power with men,” adds conference cochair Elisa Saitovitch, an experimental condensed matter physicist at the Brazilian Center for Research in



Participants at the Second International Conference on Women in Physics say their conversations were deeper this time around, now that they’re getting to know each other.