that US private industry involvement in the science centers and other US–FSU nonproliferation programs has been difficult. A significant hurdle for companies, he said, is the issue of access. Most of the FSU weapons scientists live in the nuclear, or secret, cities that were scattered around the Soviet Union. They were "closed" cities during the cold war and remain high-security cities today.

"For an ordinary person, there is 45 days' notice that must be given to get access to these cities," von Hippel said. "And then they can turn you down, so you don't know if you can visit your investment. To make a major investment when you don't even know if you can visit that investment is a real downer," he said.

Despite the difficulties, both von Hippel and Neff said that the science centers program is performing an important mission in keeping some money flowing to FSU scientists. "It's a temporary solution," Neff said of the program. The long-term solution to underemployment of thousands of former weapons scientists won't come from outsiders, he said. "The Russians are going to have to invent a solution themselves. All we can do is give them some help. And it may just be temporary projects, or it may be a modest annuity for their scientists to put bread on the table. The nuclear cities don't have enough money to pay all of these people, so what we are doing for now is supplementing the budget. They throw some of the people they can't pay onto these grants, and it reduces the load on the Russian budget."

Von Hippel agreed, saying, "It's legitimate to call [the science centers program] a welfare program. But it is of critical importance. The typical salary of a Russian scientist, at least until recently, was $200 a month. The State Department program is a significant amount of the money going into those institutions, and it actually goes into the individual bank accounts of the scientists, with some going back to the institutes they work for."

And the economic problem facing the individual weapons scientist is a "collective phenomenon" faced by the nuclear cities as a whole, von Hippel said. The Russian Ministry of Atomic Energy (MINATOM) "is keeping many more scientists on the payroll than they need. They are concerned about destabilizing the cities by having too many without jobs."

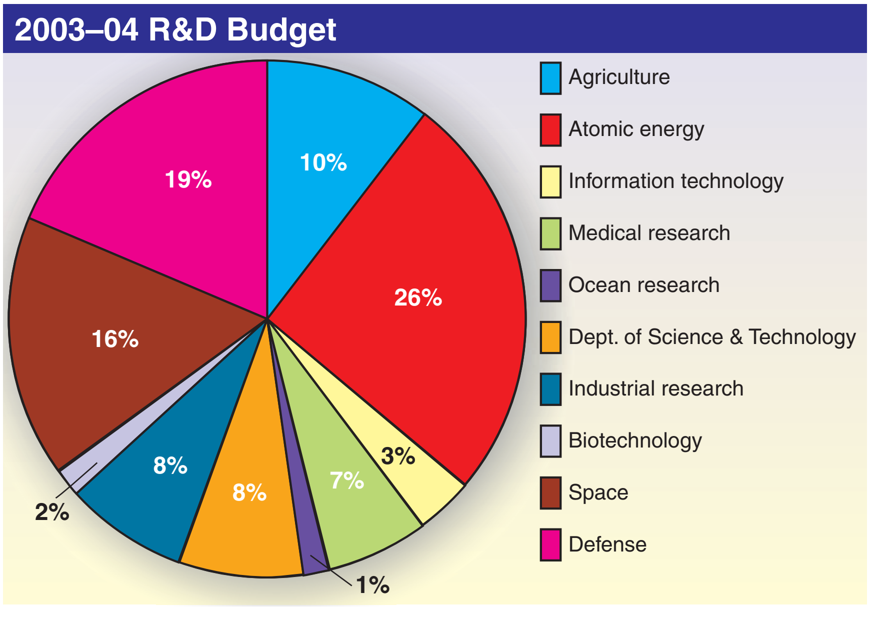
"What we're doing is a holding pattern for what is eventually going to have to be a fundamental transformation in the Russian system," Neff said. Given the dependence of the weapons scientists on funding from the US and other countries, "God only knows what will happen if it stops. So it's time to start thinking of how do we get from a holding pattern to longer-term change. I keep looking for Occam's razor, the simple thing that doesn't cost too much."

**Jim Dawson**

# India Ups R&D Investment

India will almost double science and technology funding from 1.1% to 2% of gross domestic product (GDP) by 2007, according to a policy document released by Prime Minister Atal Bihari Vajpayee in January at the Indian Science Congress in Bangalore. "The document sets the priorities in place and provides a road map for the next few decades," says Valangiman Ramamurthy, secretary of the government's department of science and technology. "But progress would depend essentially on how vigorously and in what manner its major provisions are implemented," says Rajendra Pachauri, director general of the Tata Energy Research Institute in New Delhi.

*Science and Technology Policy 2003* proposes cutting bureaucracy at India's science agencies, providing universities and research institutions with greater autonomy, and improving university infrastructure. Other objectives include tax breaks for firms willing to invest in R&D; attracting expatriate scientists to return to India; increasing funding for research on natural disasters; and promoting more efficient, environmentally friendly, and clean technologies.



GOVERNMENT OF INDIA

This is only the third time in the 56 years since India acquired its independence from the UK that the country has formulated a new research strategy. In 1958, the government released its first scientific policy resolutions, which proposed strengthening higher education, forming specific research institutes in areas such as nuclear and space technologies, and improving industrial infrastructure. The second policy statement, made available in 1983, recommended that India either engage in reverse engineering—which involves disassembling an object to see how it works in order to duplicate its manufacture—or obtain licensing agreements for goods that it could not manufacture. "Although the 2003 document rephrases a lot of what was contained in the original policy resolutions, there are some significant new ideas in it," says Abhijit Sen, dean of the Institute for Plasma Research (IPR) in Bhat.

The new report's recommendation that India increase public awareness of science and technology is welcomed by Pachauri. For democracy to be effective, he says, people need to understand the impact of science and technology. The report also proposes that the country's researchers concentrate on meeting the needs of the poor population. "The large mass of [India's] poor people have generally been neglected," Pachauri adds. Instead, research has tended to focus on solving problems for India's upper and middle classes. He points out that government-funded research in areas such as sustainable development can make a huge difference in eliminating poverty.

In the 2003–04 budget, science and technology funding received a 9.5% increase to INR 146 billion ($3.1 billion), despite a generally weak economy. Nearly 80% of the R&D money in India is provided by the government, yet almost all the increase proposed in the 2003 strategy document would come from industry. "We are seeing a very encouraging response to industry participation in R&D," says Ramamurthy. "Indian industries [are looking] to technology to give them the competitive edge," he adds. There is more than an even chance that the 2% GDP goal can be met, says Predhiman Kaw, director of the IPR, "but the contribution from industry may be slow coming and tend to be very selective."

"The strength of India's current R&D effort lies in the large, diverse, and qualified scientific human resource that the country possesses," says Pachauri. "Its weakness is essentially in the largely inefficient institutional structure, symbolized by government-funded research laboratories, which have remained essentially stagnant and unproductive for much too long."

Most of the funding goes to India's 200 state-run and 1350 industrial laboratories. The government also funds 230 universities. The policy calls for a radical shakeup at these institutions and increased mobility of scientists among industry, academia, and research laboratories, and between fields. The universities will welcome the report, says Kaw, because it gives "clear recognition of the fact that they are the ultimate source of trained manpower, and that their infrastructure needs considerable upgrading with new investments." However, according to Katepalli Sreenivasan, the new director of the International Centre for Theoretical Physics in Trieste, Italy, "the report does not recognize the importance of first-rate undergraduate science education in the universities, which is where most of the raw talent for scientists exists."

Pachauri agrees. "India had some excellent universities half a century ago, but many of these have declined in quality and caliber for a variety of reasons, particularly lack of government support. . . . It is hoped that the new policy will correct this historical trend and bring about a strengthening of the university system as far as science and technology is concerned."

The document's influence may be felt beyond India's borders. "Many developing countries view Indian science policy as visionary," says Sreenivasan, "and the document is well in that spirit." **Paul Guinnessy**

## DESY Laser Gets the Nod, Collider Bid Deferred

The German Electron Synchroton (DESY) in Hamburg recently received good news and not-so-good news in a single breath: On 5 February, Germany's science ministry announced that it will ante up €337 million ($363 million), or half the cost of the lab's proposed x-ray free electron laser (X-FEL), but that, at least for now, it will not commit to the lab's ultimate goal of building a superconducting electron–positron collider, a contender to become the world's next-generation particle accelerator. Both projects got conditional endorsement last year from Germany's national science council (see PHYSICS TODAY, November 2002, page 24).

Because DESY had hoped to garner greater support for TESLA, its proposed TeV-Energy Superconducting Linear Accelerator, the government's decision to defer is disappointing. "Some people took the announcement as bad news, others took it as good news," says Allen Caldwell, a particle physicist from Columbia University and the Max Planck Institute for Physics in Munich. "But the realists say that, given the state of the economy in Germany—and everywhere else—it's as much as could be expected for now."

For his part, DESY Director Albrecht Wagner says "the outcome is very good. The decision provided the lab with a clear direction and perspective: Build the X-FEL, and keep going with the linear collider R&D." Next, DESY needs to enlist international partners for the X-FEL and to sort out financial, design, and organizational aspects of the project.

Superconducting accelerator cavities are the backbone of the 1.4-km X-FEL and 33-km TESLA alike. "Going through the process of bringing something from the lab into industry is a major step," says Wagner. "Clearly the linear collider will benefit from building the free electron laser."

Meanwhile, collider designs being developed in the US and Japan would rely on "warm," nonsuperconducting technology. But whichever technology is used, and wherever it is sited, the consensus is that the multibillion-dollar next-generation linear collider has to be an international project (see PHYSICS TODAY, September 2001, page 22). Indeed, Wagner says Germany plans to participate in the next linear collider wherever it is sited, but that the government "felt that a unilateral German move might be counterproductive for the international negotiations."

And whether or not TESLA ever gets built, the X-FEL secures DESY's future. The X-FEL will provide femtosecond light flashes orders of magnitude more intense than today's light sources, says Wagner. "This makes it an ideal stroboscopic lamp for rapid processes." To be sure, research on the X-FEL would stray from DESY's historic strength in particle physics and put more emphasis on condensed matter physics, plasma physics, chemistry, and biology. **Toni Feder**

## European Spallation Source: Dead or Alive?

The aspiring European Spallation Source has no doubt suffered setbacks, but whether it is dead or just delayed is a matter of perspective.

"Chances are [the ESS] will be shelved," says Peter Tindemans, chair of the ESS council and an independent policy expert in the Hague. "Of course, I am not happy about this. It would be a setback for Europe vis-à-vis the United States and Japan," which expect to complete, respectively, 1.4 MW and 1 MW spallation sources in 2006. If it's built, the ESS will outdo them, with two 5 MW experimental stations. If it's not, Europe will cede its long-held leadership in neutron science.

Low marks in Germany's review of big facilities last year were followed in February by no money for the ESS when that government announced which facilities it would fund (see PHYSICS TODAY, November 2002, page 24). The ESS received another blow early this year, when the European Strategy Forum on Research Infrastructures concluded that the countries of Europe are not presently willing to pay for the project, which would cost an estimated €1.5 billion ($1.6 billion).

"It would be unwise to say there haven't been setbacks," says Bob Cywinski, a neutron physicist at Leeds University in the UK and a scientific adviser to Yorkshire's bid to host the