

research sciences, which appear in the 6.1 account, meets the President's request. Congress also increased the appropriation for the Defense Advanced Research Projects Agency by more than \$320 million, to accommodate the funding of high-tech projects that promise to improve US economic competitiveness. (See the following story.) The conferees agreed to the full \$20 million requested for the DOD Graduate Fellowship Program and accepted the House proposal to add \$50 million for new graduate programs to be used "in the best manner to increase and maximize the quantity of scientists and engineers resulting from Defense-sponsored research."

Although DOD's University Research Initiatives program received the full amount of the President's request, \$98.7 million, it also got an extra \$75 million for "pork barrel" projects, mainly at universities. During a heated debate on the legislation, Sam Nunn, the influential Georgia Democrat who heads the Senate armed services committee, supported by John Danforth, a Republican from Missouri, objected to the earmarking when the Senate hadn't discussed the matter, and promised to revisit the issue in the 102nd Congress.

After NASA, which took the cruellest hit from President Bush's request, the agency most affected by the new budget is DOE. Magnetic fusion research was funded at \$275.3 million, down nearly 17% from fiscal 1990. Layoffs are already taking place at the Princeton Plasma Physics Lab, and construction of the Compact Igni-

tion Tokamak is on hold for the time being at least. By contrast, inertial fusion, located in the DOE defense program, received additional sums for upgrading the Omega laser at the University of Rochester and the Nova laser at Lawrence Livermore.

The Superconducting Super Collider, which had been protected during most of the negotiations by Texas Senators Lloyd Bentsen and Phil Gramm, lost \$75 million from its \$318 million request—though these powerful forces were able to restore to the 1991 budget the \$25 million in "construction" funds enacted but withheld by Congress last year. Just before Congress adjourned, the Texas National Research Commission, which controls the \$1 billion set aside by the state for the SSC, agreed to release nearly \$150 million in two phases to make up any shortfalls in the project, which DOE now officially figures will to cost \$8.24 billion.

The Relativistic Heavy Ion Collider, to be built at Brookhaven, and the Continuous Electron Beam Accelerator Facility, nearing completion at Newport News, Virginia, were fully funded at \$15 million and \$65 million, respectively. But \$33 million was taken from the President's request for \$621 million for high-energy physics, and \$17 million was withdrawn from the \$331 million proposed for nuclear physics. These reductions are most likely to come from lab operations. Made in the final hours of the budget negotiations and without consultation with DOE officials or lab directors, the cuts angered SLAC Director Burton

Richter, who decried the "absentmindedness of weary conferees... who consider projects in a narrow box. With this budget the country's research enterprise is hurtling from stress to misery."

DOE's request for Basic Energy Sciences was increased by about \$68 million. This was done to compensate for most of the \$98.8 million in pork earmarks made by members of the House and Senate appropriations committees for specific academic research facilities in their home districts. The Basic Energy Sciences program will have to make up the difference of about \$20 million from its traditional programs, such as materials research and chemical science, or from construction funds at DOE laboratories. Congress also added \$22.2 million of pork into DOE's biological and environmental research program, mainly for laser instrumentation to be introduced at universities with medical centers.

In the end, the five-year budget law calls for caps on discretionary spending in defense, foreign aid and domestic programs, including science, allowing these to grow only by the projected inflation rate. However, the growth estimates are based on some especially optimistic economic assumptions that do not take into account the savings and loan debacle or the Persian Gulf military operation. The caps amount to 4.9% in 1992 and 3.7% in 1993—increases that suggest a nominal spending freeze on research programs and new projects in the next few years. —IRWIN GOODWIN

SEEKING TO IMPROVE COMPETITIVENESS, OSTP ISSUES FIRST US TECHNOLOGY POLICY

To understand US government policy about emerging technologies requires the combined talents of a lawyer, CEO, scientist, engineer, linguist and mind reader. Most people aren't sure a technology policy exists, mainly because the White House insisted for years that a free market economy doesn't need one and usually behaved in ways that made its position a self-fulfilling prophecy. So imagine the surprise elicited around the country when the Office of Science and Technology Policy released a document bearing the imposing title of "US Technology Policy" and carrying the great seal of the little White House agency.

Though it is the first statement on technology policy by any Administration, the 13-page policy paper appeared in October without the hype or

hoopla that usually accompanies such publications from the White House. Indeed, according to OSTP insiders, the policy document could just as easily carry the President's own seal, because it had the approval of nearly everyone of importance in the Bush Presidency—John H. Sununu, the White House chief of staff; Michael J. Boskin, chairman of the Council of Economic Advisers; Richard G. Darman, director of the Office of Management and Budget; Nicholas F. Brady, Secretary of the Treasury; and other Cabinet members and key advisers.

"We believe we've put together a Magna Carta of technology policy," William D. Phillips, OSTP associate director for industrial technology, told members of the President's Council of Advisers on Science and Technology at their 8 November meeting.

The document is more than a restatement of Bush's election manifesto, "Building a Better America." It advances some important new ideas, which may account for the eight months the paper took to be cleared for publication. Possibly its most significant paragraph recommends that the Federal government collaborate with private industry "in pre-competitive research on generic, enabling technologies that have the potential to contribute to a broad range of government and commercial applications."

"In many cases," the paper continues, "these technologies have evolved from government-funded basic research, but technical uncertainties are not sufficiently reduced to permit assessment of full commercial potential. In precompetitive research,

which occurs prior to the development of application-specific commercial prototypes, research results can be shared among potential competitors without reducing the financial incentives for individual firms to develop and market commercial products and processes based upon the results."

This precept seems to be modeled on the operation of Japan's Ministry of International Trade and Industry, which, by all accounts of that nation's economic success, is evidently doing something right. The policy also latches on to the initiatives taken by Congress, where there is a growing sense that the Bush Administration is not active enough in improving the ability of the nation's high-tech industries to compete against foreign firms, whose R&D efforts often are supported by their governments.

Suspicion of MITI

In 1988 a task force of the House Committee on Science, Space and Technology called on the Administration to create a technology policy that would give industry, government and academe the flexibility to coordinate their R&D on generic technologies in order to create a foundation on which individual firms could build commercial products. The House task force did not propose that the US follow the MITI model. In fact, it viewed MITI with suspicion, arguing that industrial policy and central planning are anathema to America's political, economic and social experience. While the task force recommended a larger and swifter flow of advice from industry to government in fostering and funding R&D programs, it insisted that "industry is better able than government to respond to the dynamics of consumer markets."

The second sentence of the OSTP policy paper underscores this theme: "Competitive market forces determine, for the most part, an optimal allocation of US technological resources." The government's job, the paper says, is to establish a climate warm to private enterprise. Still, it notes, technology policy is not immutable. National and international conditions change, and while any technology policy needs to be based on a nation's traditions, as well as its strengths and weaknesses, it must be flexible and responsive enough to deal with new conditions and new challenges.

In a letter introducing the document, D. Allan Bromley, OSTP's director and President Bush's science adviser, writes that the policy paper is meant to embrace both a goal and a strategy and is "also intended to serve

as a baseline for future dialogue of technology issues, both inside and outside of the government." Bromley addressed the document to the chairmen of the House and Senate appropriations committees and sent copies to all members of Congress as well as heads of government agencies, leading corporate executives, and movers and shakers around the country. The distribution of some 14 000 copies in the first 40 days after its publication almost assures that the policy paper will get the attention that Bromley and his White House colleagues want.

An early section on strategy calls for encouraging more investment in emerging technologies by commercial companies through Federal monetary and fiscal policies—notably by reducing the capital gains tax for technological investments and by increasing the tax credits for "research and experimentation" (more customarily called R&D). While these are clearly in keeping with the objectives of the Bush Presidency, Phillips told us they belong in the document not only because they are essential to the overall policy but because "we're reminding ourselves and Congress that these need to be enacted into permanent laws."

In fact, Congress anticipated the Bush policy on technology in bits and pieces a decade ago with the 1980 Stevenson-Wydler Technology Innovation Act, the first attempt to codify the concept of technology transfer from Federal labs to commercial firms. Prior to Stevenson-Wydler, Federal agencies were not explicitly required to engage in technology transfer activities, with the sole exception of NASA. Since then Congress has extended and expanded tech-transfer laws several times to include Federally Funded Research and Development Centers; Government-Owned, Contractor-Operated labs; and small businesses. It also has created new programs at the National Bureau of Standards (which it renamed the National Institute of Standards and Technology) to provide a vehicle for Federal investment in industrial research consortiums and, most recently, it endorsed a section of the 1991 Defense Authorization Act directing the departments of Defense, Energy and Commerce to work together to encourage tech-transfer partnerships between the labs and the states.

OSTP also has been keenly concerned about relating the work of the national labs to industrial technologies. In 1983 a White House Science Council panel headed by David Packard, chairman of Hewlett-Packard

and former deputy secretary of the Defense Department, faulted some labs for not being "more responsive to the nation's needs." The Packard report recommended that Federal labs develop more alliances with universities and corporations as a strategy for stimulating the country's industrial competitiveness.

The OSTP policy paper goes further. "Where appropriate these laboratories should give greater consideration to potential commercial applications in the planning and conduct of R&D, and these efforts should be guided by input from potential users," says the document. "To achieve this goal, there must be a closer working relationship among these laboratories, industry and universities." Collaboration could also extend to exchanges, visits and other direct interactions among scientists and engineers to advance the transfer of knowledge and know-how firsthand. Solomon J. Buchsbaum, senior vice president for technology systems at Bell Labs and a member of PCAST, considers this concept "an interesting blueprint for the way we will do R&D in this country" and "certainly worth pursuing."

Celebration of DARPA

The document also suggests that the defense labs "can make major contributions while still providing adequate safeguards for classified information." As for the role of DARPA and the Pentagon's Research and Advanced Technology Office, there is no stated policy—though Congress is making its demands known through its funding function.

Accordingly, a provision in this year's Defense Appropriation Act more than doubles OSTP's \$3 million budget by establishing a new Critical Technologies Institute under the auspices of the White House agency. The purpose of the institute, an idea sponsored by Senator Jeff Bingaman, a New Mexico Democrat, is to "rationalize" Federal research into technologies considered critical to international competitiveness and national security. Last year Congress created a Critical Technologies Panel, under OSTP, with members drawn from DOD, DOE, Commerce, NASA, NIH, NSF, private industry and higher education, and directed it to prepare a National Critical Technologies Report every two years. The new legislation requires that the institute be established this year, with funding from the Pentagon, to help the panel and OSTP develop a strategy for Federal investment in the designated key technologies.

Congress also pumped up DARPA's \$1.2 billion budget in 1990 by \$360 million, to be spent on "generic," "enabling" and "precompetitive" technologies—this year's faddish buzzwords for research intended to promote the US economy without favoring one industry or company over others. The sum designated specifically for precompetitive technologies in the Defense budget is only half of the \$100 million that Bingaman and Representative Mel Levine, a California Democrat, had sought to enable DARPA to develop consortiums of universities, companies and government labs that would do R&D in critical technologies. Instead, the lawmakers added funds to DARPA for specific projects. Among the winners: high-performance computing, which got \$30 million more than the Administration's request of \$108 million, and x-ray lithography, used in processing the next generation of semiconductors, which received \$60 million, double the original request.

Protection through GATT

As well intentioned as Congress's actions are so far, they do not add up to the all-embracing policy put forward by OSTP. Even when the policy paper includes conventional "motherhood" language, the remarks appear to be restated as national doctrine. Consider this: "US society needs to focus on ensuring a quality work force that is educated, trained and flexible in adapting to technological and competitive change [and in furthering] the translation of technology into timely, cost-competitive, high-quality manufactured products.... With its proven human resources and successful tradition of manufacturing, US industry can assert the leadership required to meet the competitive challenges and to capitalize on the opportunities. The principal role of the Federal government will be to provide an environment conducive to long-term economic vitality and not allow special interests to divert attention or resources from this goal."

The policy statement also calls for a legal environment "that removes unnecessary obstacles to innovation," for example, by reducing uncertainties about Federal antitrust actions that could be invoked when firms cooperate in R&D or joint production ventures for new products. If this policy had been in effect in the 1970s, US car makers would have been able to jointly develop catalytic converters to reduce emissions. As it was, they were prohibited by law from pooling their research. The OSTP report recommends that companies produc-

ing technologies and computer software under government contracts be allowed to retain the rights to technical data, protect their trade secrets and market the things developed through the contracts. The policy also seeks better international protection of intellectual property in negotiations of the General Agreement on Tariffs and Trade, in trilateral talks with the European Community and Japan, and in bilateral agreements under provisions of the 1988 Omnibus Trade and Competitiveness Act. It would liberalize US controls on exporting high-technology products such as supercomputers to Eastern Europe now that the "evil empire" is rapidly disintegrating.

Another policy goal is revitalizing education at all levels—"not only the training of scientists, engineers and the technical work force, but also educating our population to be sufficiently literate in science and technology to deal with the social issues arising from rapid scientific and technical change." In this effort, says the paper, the government will need "to define an effective and appropriate role... in support of the states, localities and universities as they improve science and technology education to build human capital in the US."

The paper also speaks about the Federal responsibility increase government investment in basic research. It asserts that "private industry does not invest heavily in basic research because the payoffs are so unpredictable and diffuse that individual firms cannot be confident of fully recovering their investments." Clearly, therefore, "the long-term potential benefits of this research are so

large that society cannot afford not to make the investment, especially in university research, which in addition to new knowledge also produces trained scientists and engineers."

The policy document is not without its critics—principally because it lacks an overall plan of attack. Representative Sherwood Boehlert, a New York Republican who sits on the House science committee, complained: "For a partisan of this Administration, it's disappointing that the technology paper is not more imaginative or provocative. It is about as thorough a defense of the status quo as could be imagined."

At the PCAST meeting where the policy was discussed, Packard, a member of the council, said that the statement is "basically a good set of guidelines. Now the Administration will have to work with Congress on specific legislation so this country can move into the 21st century as a strong industrial competitor." For his part, Bromley, the chairman of PCAST, said support for the policy "just wasn't there at the beginning of our exercise. Now there's solid support by the Bush Administration."

After the meeting, Packard told us that the policy statement reminded him of the fundamental revelation that Presidents and their men don't simply issue orders and watch them carried out. Indeed, it was President Truman who once summed up the exercise of Presidential power in two sentences: "I sit here all day trying to persuade people to do the things they ought to have sense enough to do without my persuading them.... That's all the powers of the President ever amount to." —IRWIN GOODWIN

SCIENCE ADVOCACY DEALT A BLOW IN ELECTIONS FOR 102nd CONGRESS

For weeks before the 1990 midterm elections, political pundits thought they detected an angry "throw the rascals out" attitude toward many incumbents in Congress. But when the ballots were counted, voters returned 96% of the House members and 97% of the Senate incumbents. Still, two longtime members who served on the House Committee on Science, Space and Technology were unexpectedly defeated, and another committee member lost after giving up her seat to run for the Senate. A possibly more significant loss for science was the defeat of Robert W. Kastenmeier, a crusty Wisconsin Democrat who, when only a sopho-

more congressman, lobbied the House, against President Kennedy's wishes, to create the Arms Control and Disarmament Agency.

The casualties on the science committee are Doug Walgren, a Pennsylvania Democrat who was seeking his eighth term, and Jack Buechner, a feisty Missouri Republican in quest of his third term, both dedicated defenders of basic research programs at the National Science Foundation, Department of Energy and NASA. Walgren, who last year gave up his chairmanship of the Subcommittee on Science, Research and Technology, though he continued as a member, to take on the leadership of the Subcommittee on