R&D budget: Civilian gains outpace defense

President Bush this week set in motion the tortuous annual task of establishing a federal budget for the next fiscal year, which begins next Oct. 1. While the proposed 1991 budget would increase research and development (R&D) by $2 billion, or a modest 3 percent – a rate below the estimated 4.1 percent annual rate of inflation – this overall figure hides a relatively new trend: Civilian activities get the bulk ($1.5 billion) of the increase, three times the dollar increase proposed for defense-related activities.

Although defense would still dominate the R&D budget, it would command only 61 percent of the R&D pie – down from its 64 percent share in 1990 and a record 69 percent in 1986. At a briefing this week, Presidential Science Adviser D. Allan Bromley said he believed the proportion of R&D funds earmarked for defense would continue to shrink in future years, at least for areas outside basic research. Overall, the proposed R&D budget of $65.7 billion represents slightly more than 5 percent of the President's total budget of $1.23 trillion.

Hefty slices would go to four ongoing projects:

- a $900 million increase (24 percent) for the Strategic Defense Initiative, for a total of $4.7 billion.
- a $105 million (56 percent) increase for the Superconducting Super Collider, for a total of $293 million.
- a $68 million (79 percent) increase, for a total of $154 million, to the human genome project, designed to identify the structure and order of all human genes.
- a doubling of funding, for a total of $100 million, for the Agriculture Department's grants program, designed to attract more academic scientists to agricultural research.

The administration would divide other slices of the R&D pie among a number of programs, some old and some new, in a variety of disciplines.

National Science Foundation: This agency's proposed $2.38 billion budget would provide a 14.4 percent ($300 million) increase, aimed at doubling NSF's 1987 funding level by 1993. While basic research commands the largest chunk of NSF funds ($1.95 billion) and the largest dollar increase ($229 million), the proposed budget for science and engineering education, set at $251 million, represents the largest increase, at 23 percent, which would constitute 45 percent of all federal science education funds. Of this money, $128 million would continue to fund training grants to draw new researchers, primarily minorities and women, into science careers. In particular, programs aimed at restructuring science and mathematics courses nationwide in kindergarten through grade 12 would total $165 million, a 17.8 percent increase. Efforts to improve undergraduate education and provide research opportunities for undergrads would increase by $44 million (48 percent), for a total of $134 million.

Engineering research on biological and critical systems would undergo an 8.4 percent reduction, while grants in other areas such as chemical and thermal systems, electrical and communications networks, design and manufacturing, and mechanical and structural systems would see cuts ranging from 3 to 4 percent – all before accounting for inflation. Though some of these studies might be funded through a new NSF engineering program emphasizing collaborative research, that initiative is intended primarily to attract more people to the field rather than to target a specific research area within engineering.

Physics research grants would fare only slightly better in the President's NSF budget. The grants, which rose 1 percent in the recently finalized 1990 budget, would increase by a similarly modest 5 percent in 1991, as would chemistry and materials research. (In contrast, research grants in the biological sciences would rise 7 to 10 percent.) However, six of the 11 science and technology centers that NSF plans to begin funding in 1991 – to the tune of $52 million – would focus on astronomy or physics research.

Other NSF funding would include:

- $47 million to begin building highly sensitive gravitational-wave detectors at the California Institute of Technology in Pasadena and at the Massachusetts Institute of Technology in Cambridge. In search of a type of radiation never observed but predicted by Einstein's theory of gravitation, the twin detectors will sense vibration-induced changes along their 4-kilometer length down to a fraction of an atomic nucleus.
- $4 million to begin construction of two 8-meter telescopes, one each for the Northern and Southern hemispheres, for detecting optical and infrared light.
- an increase of $23.3 million in the U.S. Antarctic program, including $17 million to continue environmental cleanup (SN: 10/22/88, p.262).

Earth sciences: In January 1989, a newly formed interagency group called the Committee on Earth Sciences (CES) announced it was developing an integrated federal R&D action plan for investigating issues related to the climate changes that scientists expect to result from human activities such as fossil-fuel combustion and the use of ozone-destroying pollutants. CES analyzed all federal programs that might be construed as tackling climate-change issues, identified gaps or redundancies of effort, and last July published its prioritized list of additional research needs – beginning with studies on the role of clouds, on ocean circulation and heating, and on the transfer of trace gases between land, oceans and atmosphere. For the first time, the President's new budget proposal translates those needs into an organized research program.

Spending on this centrally coordinated "global change" program during the 1991 fiscal year would climb to $853 million, an increase of 43 percent. If one adds in the money this plan would authorize for spending in succeeding years, the overall scheduled increase is 57 percent.

NASA ventures dominate the new program, accounting for 65 percent of the plan's R&D total. A new Earth Observing System highlights global change initia-

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FY 1991 R&D Funding
(Dollar amounts in millions)

Department or Agency	Outlays* 1989 Enacted	1990 Enacted	1991 Proposed	Percent Change
Conduct of R&D:				
Defense-military	37,545	37,064	37,547	+ 1.3
Health and Human Services	7,486	8,055	8,568	+ 6.4
Energy	5,692	5,599	6,019	+ 7.5
NASA	4,975	5,773	7,547	+ 30.7
National Science Foundation	1,557	1,744	1,944	+ 11.5
Agriculture	1,021	1,084	1,156	+ 6.6
Interior	478	469	499	+ 6.4
Environmental Protection Agency	345	393	435	+ 10.7
Other Agencies	1,783	1,904	1,918	+ 0.7
Subtotal, Conduct of R&D	60,882	62,085	65,633	+ 5.7
R&D facilities	2,054	2,590	2,738	+ 5.7
Total	62,936	64,674	68,371	+ 5.7

Derived from OMB data; all figures reflect rounding

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tives scheduled for their first funding in the coming year. This highly instrumented series of satellites would make improved measurements of factors important to climate change, including several relating to clouds. It would also measure sea-surface temperatures, wind speeds, ocean heights, chemical and temperature profiles of the atmosphere, cloud heights and concentrations, ice concentrations and changes in land-vegetation patterns, and would even send back the first real-time global measurements of plate-tectonic movements near faults, says Shelby Tilford, director of NASA's division of earth science and applications in Washington, D.C. Another new high-priority research effort called for in the global change program would use stationary buoys and shipboard studies to make the first detailed maps of ocean temperatures and salinity in widely separated regions of the world.

For the 10th straight year, the $14.3 million National Undersea Research Program faces termination. Each year, Congress has reinstated funding for this program, which includes, among other activities, expeditions with the submersible ALVIN to mid-oceanic ridges. Last year's fight between Congress and the administration over whether to keep funding two failing remote-sensing satellites (SN: 3/18/89, p.172) may also repeat itself. Bush has not requested any 1991 funds for operating the aged Landsat 4 and 5 satellites, scheduled for replacement in July 1991 by the launch of Landsat 6. If Landsat 4 and 5 continue working through September 1990, the administration will again need to find funds to keep them going.

Finally, as part of a drive to modernize the National Weather Service, the administration would boost funding to that agency, largely for additional doppler weather radar systems, a new technique the service will begin using his year.

Biomedicine: The President's budget would hike AIDS-related funding by 18 percent, to $3.5 billion. About $1.2 billion of this is slated for research and $1.3 billion for treatment. Of the research money, $800 million would go to the National Institutes of Health. NIH would receive a total budget of nearly $8 billion, an increase of 4.7 percent. About $4.4 billion would fund research grants, representing an increase of 5.4 percent over 1990. The number of new and competing NIH research grants, often regarded as a measure of the federal government's ability to fund more biomedical researchers, would increase by nearly 10 percent to a total of 5,095. At the Alcohol, Drug Abuse and Mental Health Administration, funding for drug abuse research, prevention and treatment would rise by nearly 15 percent to $1.4 billion, reflecting the Bush administration's stance on the nation's addiction problems.

Environment: The administration inherited several critical environmental problems last year — most notably severely deteriorated nuclear-weapons plants and an epidemic of cities failing clean-air standards. In the new budget proposal, Bush recommends major funding increases to address both. The Energy Department, for example, would increase spending for environmental restoration and waste management at its defense, nuclear and research facilities by 26 percent, to $2.8 billion. This is still just a fraction of the estimated $20 billion cost of the five-year facilities-cleanup program. The budget proposal also recommends earmarking another $82.5 million to fund new or augmented EPA activities following passage of the Clean Air Act amendments (SN: 6/17/89, p.375), expected later this year, as well as 22 percent more (to $418.5 million) for EPA enforcement of environmental laws.

With the National Acid Precipitation Assessment Program's completion this year, EPA will phase out about $18 million in acid-rain programs. Under the new budget plan, Bush would redirect the anticipated savings into a range of other areas. Water-quality programs to support wetlands preservation and oil-spill cleanups, for example, would increase $2.2 million, or 7.6 percent. EPA's toxic substances research would climb $1.9 million, or 6.6 percent. Radon studies would increase 7.5 percent, to $1.7 million, and EPA's programs to help local governments limit pesticide contamination of workers, wildlife and groundwater would mushroom to $7.4 million, an increase of roughly 24 percent. Finally, a whopping $17.1 million increase (22 percent) is slated for EPA's air research. That money would fund such efforts as analyzing how alternative fuels might improve air quality, modeling smog-ozone generation in urban areas and investigating indoor air pollution problems.

Energy: Funding for research into conservation and renewable energy sources — such as innovative lighting technologies, photovoltaics and biofuels — suffered greatly under the Reagan administration, which contended such projects were best left to the private sector. The new Bush proposal, in contrast, tops its list of new program "themes" with a vow to increase its "commitment" to conservation and renewables. Next year's funding for these programs would increase 8 percent over the $333 million authorized by Congress this year — a 78 percent increase over the level Reagan requested last January.

Several of the Energy Department's more traditional research areas would not fare as well. Overall, coal R&D would be cut 60 percent, to $110 million. The department's $40 million magnetohydrodynamics program would be killed. Surface coal-gasification efforts would plummet 60 percent, coal-liquefaction programs 70 percent and fuel-cell research more than 70 percent. Though the department's $24.4 million light-water nuclear reactor program is slated for a 30 percent R&D increase in the coming year, its $320 million magnetic fusion effort would merely hold its own pending results of an independent advisory panel's review of the program, due later this year. And while Bush would more than triple funding to develop advanced technology for extracting and processing petroleum, he would all but eliminate oil-shale research.

Space sciences: NASA's total budget of $15.1 billion represents an increase of $2.8 billion (4.3 percent), $2.6 billion of it for the long-planned space station. According to NASA Administrator Richard H. Truly, "This will be the year that Space Station Freedom makes the critical transition from design to fabrication of major long-lead-time hardware." It should be ready for permanent occupancy in mid-1997, he says — if NASA gets the money sought this year.

The NASA budget also includes money to deploy several small satellites called Earth Probes, for use in the global change program. There are preliminary funds to develop a satellite called Lunar Observer, planned for launch in 1996 to study the moon's entire surface from a pole-crossing orbit. Some planetary scientists have tried for more than a decade to get this project started, but the proposed funds for it are listed merely in the "research and analysis" section of NASA's planetary budget, a category primarily used to study data already in hand.

Physics and materials: Long a neglected stepchild in the federal R&D budget, the National Institute of Standards and Technology would enjoy an increase of $36.5 million, or 22 percent. With inflation taken into account, this would be the institute's first funding increase since 1975. Areas targeted for the increase include chemical measurements and standards, bioprocess engineering, light-wave measurement technology, computer security, advanced semiconductors and high-temperature superconductors.

The Energy Department's budget also includes several large increases for physics research. High-energy physics would rise by 6.7 percent to $621.2 million, $140.3 million of which would go to research groups conducting experiments or theoretical work. Construction projects included in this physics budget total $38.8 million, including $12 million for upgrading the linear accelerator at Fermilab in Batavia, Ill. The department's nuclear physics budget would jump by 14 percent to $330.7 million, including funds to keep building the continuous electron beam accelerator facility and the relativistic heavy ion collider.

— R. Cowen, J. Raloff and staff reports