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R&D Trends and Special Analyses

(R&D by Function; Character of Work; R&D at Colleges and Universities; Outyear Projections to FY 2007; "FS&T" Budget)

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HIGHLIGHTS

- The Bush Administration would once again place a high priority on **defense R&D and health R&D**. Defense R&D (up 9.9 percent to $58.8 billion) and health R&D (up 13.8 percent to $28.3 billion) would together make up more than three-quarters of the federal R&D portfolio, and their shares are increasing. R&D funding for most other **national missions** would decline (see Table I-4).

- The federal investment in **basic research** would grow by 7.9 percent or $1.9 billion to an all-time high of $25.5 billion, primarily because of a 9.0 percent requested increase for basic research at the National Institutes of Health (NIH). Basic research excluding NIH would also increase by 6.5 percent to $11.1 billion, though primarily because of an accounting change at NASA. The total **federal investment in research** (basic and applied) would increase 6.5 percent to $51.9 billion, but excluding a large increase for NIH all other federal research would fall 0.2 percent to $26.3 billion (see Table II-1).

- The most recent data show that **R&D performed at colleges and universities** increased a solid 9.2 percent to $30.1 billion in FY 2000, with similar or larger increases expected in more recent years thanks to continuing growth in the NIH budget (see Table I-8). The federal government funds 58 percent of all R&D at colleges and universities, nearly two thirds of which comes from NIH.

- The AAAS analysis of the **outyear projections in the FY 2003 budget** shows that nondefense R&D would increase from $49.7

billion in FY 2002 to $58.8 billion in FY 2007, a gain of 8.2 percent after adjusting for expected inflation (see Table I-11). NIH would be responsible for most of the increase; excluding NIH, nondefense R&D would rise only 1.6 percent in inflation-adjusted terms between FY 2002 and FY 2007. Defense R&D would climb to a peak of $65.9 billion in FY 2005 before declining to $63.3 billion in FY 2007, still an 8.1 percent inflation-adjusted gain over FY 2002.

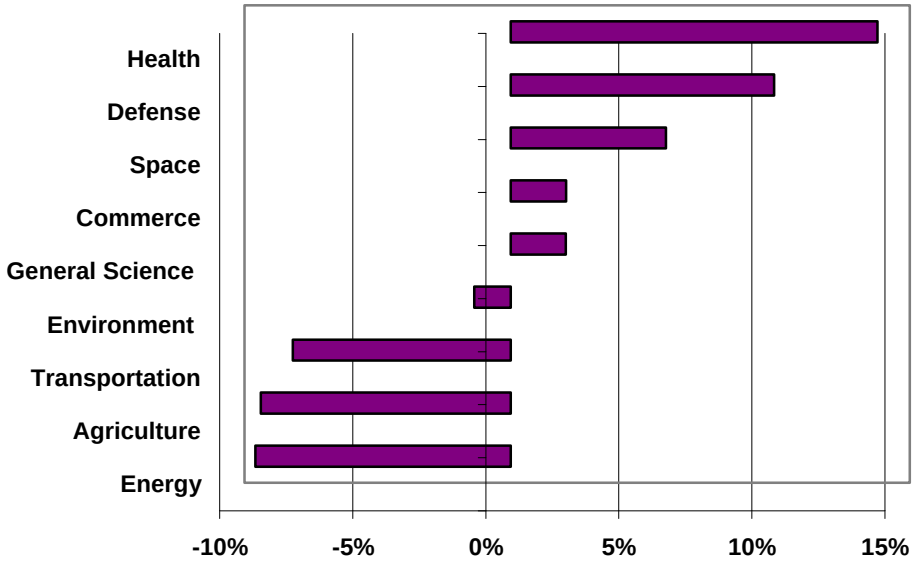
- The **"Federal Science and Technology (FS&T)" budget** is a collection of selected R&D and non-R&D programs that emphasize basic and applied research and the creation of new knowledge or technologies. The Office of Management and Budget (OMB) created the FS&T budget as a successor to the Clinton Administration's "21st Century Research Fund." The FS&T budget would increase 8.9 percent to $57.0 billion in FY 2003 (see Table I-7).

R&D BY NATIONAL MISSIONS (BUDGET FUNCTIONS)

The federal government divides the budget into 20 "functional" groupings to illustrate national priorities, each with a function number. (AAAS separates the general science, space, and technology function (function 250) into its subfunctions of General Science (251) and Space (252). AAAS also counts Department of Veterans Affairs R&D programs in the health (550) function instead of veterans affairs (700).) The congressional budget resolution divides the total budget "pie" into functional "slices," which serve as non-binding guides for appropriators in allocating funds to agencies and programs. Viewing the R&D budget by function sheds light on the funding priorities assigned to different areas over time. Table I-4 shows R&D by function in the FY 2003 budget. (Chapter 1 discusses historical trends in the functional distribution of federal R&D.)

The Bush Administration would once again, as it did last year, place a high priority on defense R&D and health R&D. Both defense R&D (up 9.9 percent to $58.8 billion) and health R&D (up 13.8 percent to $28.3 billion) would increase substantially and would together make up more than three-quarters of the federal R&D portfolio. R&D funding for most of the other national missions would decline (see Figure 1).

Figure 1. FY 2003 R&D Request by Mission
Percent Change from FY 2002



Source: AAAS, based on OMB R&D Budget Data and agency estimates for FY 2003.

Defense (050) R&D, which includes R&D activities in the Department of Defense (DOD) and the defense-related atomic energy activities of the Department of Energy (DOE), has accounted for the majority of R&D for the past two decades. Nondefense and defense R&D almost reached parity in FY 2001, but in the aftermath of the September 11 terrorist attacks defense R&D climbs sharply in FY 2002.

The Bush Administration would continue to widen the gap between defense and nondefense by aggressively expanding defense R&D investments to fulfill campaign promises and to build up DOD capabilities to fight current and future wars (see Chapter 6 for more information on the DOD portion of the defense request; see Chapter 9 for more information on DOE's defense R&D).

Health (550) R&D would continue to be the dominant mission on the nondefense side as a result of a Bush campaign promise to continue the effort to double the NIH budget between FY 1998 and FY 2003. Health-related R&D would total $28.3 billion in FY 2003, an increase of $3.4 billion or 13.8 percent, mostly for R&D at NIH to complete the NIH doubling effort but also for R&D funded by other agencies within the Department of Health and Human Services (HHS) and by the Department of Veterans Affairs' (VA) medical and prosthetic research program. Health R&D would make up more than half the nondefense R&D portfolio and 25.3 percent of the total R&D portfolio, reflecting consistent growth in NIH's budget over the past few decades.

R&D funding for many of the other national missions would decline (see Figure 1). Although space (252) R&D would increase 5.8 percent to $9.8 billion, most of the increase would be due to the reclassification of some non-R&D costs as R&D beginning in FY 2003. General science R&D (251; up 2.1 percent) and commerce R&D (370; up 2.1 percent) would barely stay ahead of inflation, but all other R&D missions would see cuts. There would be steep cuts to energy (270) R&D (down 9.6 percent to $1.4 billion), transportation (400) R&D (down 8.2 percent to $1.6 billion) and agriculture (350) R&D (down 9.4 percent to $1.8 billion). Although energy is a high priority for the Bush Administration, the major focus for the Administration's national energy policy is on the supply side by opening up new fossil or nuclear energy sources, with government R&D playing a smaller role than in previous Administrations. The Bush Administration has stated that R&D on energy technologies should be funded primarily by the private sector

rather than the federal government, and thus would scale back many of the energy R&D technology efforts funded by the Department of Energy (DOE). Transportation R&D would decline because transportation spending is tied closely to transportation tax revenues; with an economic slowdown depressing gasoline tax revenues, all forms of transportation spending would decline in FY 2003 unless Congress intervenes to use funds from other sources. Agriculture R&D would decline primarily because the Administration would not renew more than $100 million in congressionally designated research projects, and because FY 2002 funding for agriculture contains one-time emergency funding to improve security at biological laboratories against possible terrorist attacks.

CHARACTER OF WORK FOR R&D

Statistics on federally funded R&D generally make distinctions among basic research, applied research, development, and R&D facilities and capital equipment—terms that describe the "character of work" in R&D programs. (See Appendix 2 for definitions.)

The figures shown in Tables I-5, I-6, and II-1 represent agencies' best attempts to classify basic and applied research, development, and R&D facilities within their R&D portfolios. The data reported here are imprecise and reflect the agencies' judgments as to how their R&D fits into the definitions for character of work. Table II-1 shows that basic research would climb 7.9 percent or $1.9 billion to an all-time high of $25.5 billion in the Bush FY 2003 budget, primarily because of a 9.0 percent requested increase for basic research in NIH. NIH would provide the majority (56 percent) of federal basic research. Basic research excluding NIH would rise by 6.5 percent to $11.1 billion in FY 2003, but most of the increase would be due to a 20.1 percent jump in NASA's reported basic research for FY 2003 mostly from accounting changes rather than programmatic increases.

The total federal investment in research (basic and applied research) would increase 6.5 percent to $51.9 billion (see Table II-1), but excluding a large increase for NIH all other federal research would fall 0.2 percent to $23.8 billion. NIH's applied research would increase by a particularly large $2.0 billion or 20.4 percent, outpacing growth in basic research, because the FY 2003 high-priority areas of cancer and counter-bioterrorism involve significant work in applied rather than basic fields. Development would increase 11.8 percent to $55.2 billion in FY 2003

because of an enormous infusion of funds for DOD's development of weapons systems, including national missile defenses, new fighter planes, and an array of other expensive future weapons systems.

The character of work is quite different in defense and nondefense R&D, a point illustrated in Table I-6. Development would be by far the largest component of defense R&D, accounting for 87 percent of the FY 2003 total, while applied research would be 10 percent and basic research would be only 2 percent. In nondefense R&D, by contrast, basic research would be the largest category at 45 percent, with development at only 8 percent and applied research at 38 percent. A major reason for the difference between the character of defense and nondefense R&D is that development in DOD includes testing and evaluation of weapons systems. These activities are extremely expensive compared to other types of R&D. R&D facilities and capital equipment costs make up 8 percent of nondefense R&D and only 1 percent of defense R&D; the nondefense ratio is up sharply from previous years because NASA has recently reclassified the International Space from a mostly development project to a mostly facilities construction project.

The composition of the federal R&D portfolio has been shifting dramatically over the years, as shown in Table I-5, primarily because of declines in defense development in the post-Cold War era and increases in NIH support of basic research. At the height of the Cold War, development (mostly in DOD) made up nearly two-thirds of the federal R&D portfolio, but now makes up only 49 percent. Basic research, meanwhile, has steadily expanded its share of the federal R&D portfolio from 14 percent in FY 1980 to 17 percent in FY 1990 to 23 percent in FY 2003.

R&D IN COLLEGES AND UNIVERSITIES

Despite their comparatively small share of federal R&D funding, colleges and universities have long played a key role in the nation's R&D effort. Academia performs a slight majority of federally funded basic research and is also responsible for the training of future scientists and engineers. As shown in Table I-8, 58 percent of the R&D performed by universities is funded by the federal government, with most of the rest coming from the institutions' own funds. Universities still receive relatively little support from industrial firms for R&D ($2.2 billion in FY

2000, just 7 percent of the total), although industry support for academic R&D is growing rapidly.

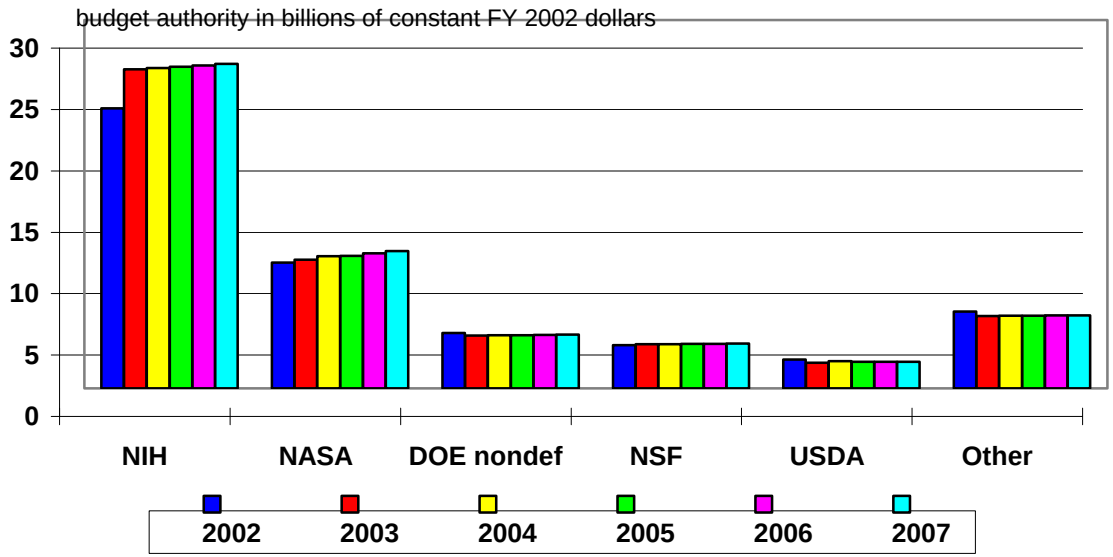
Nearly two-thirds of federal R&D at colleges and universities comes from NIH. NIH's dominant funding role in federal R&D at universities affects the mix of science and engineering disciplines in universities' R&D portfolios. R&D in the life sciences is now the majority of R&D performed at colleges and universities (58 percent of all R&D performed; see Table I-8), most of which is federally funded. Other disciplines such as engineering and the physical sciences now account for far smaller shares of total academic R&D than in past years and are dwarfed by the life sciences at 15 percent and 9 percent, respectively, of the total university R&D portfolio, each a percentage point smaller than the year before.

OUTYEAR PROJECTIONS FOR FEDERAL R&D TO FY 2007

The FY 2003 budget also contains detailed projections for federal spending, as required by law, to FY 2007. Although these projections are mostly mere extrapolations of current policies, they are a statement of the Bush Administration's budgetary priorities and their implications for the future of federal R&D. The AAAS analysis of these outyear projections reveals that the Bush budget would hold most discretionary programs to inflationary growth over the next several years, allowing most R&D programs to just stay even with expected inflation; but because NIH and DOD, the two largest federal R&D funding agencies, would continue to be high priorities of the Bush Administration, the overall federal R&D portfolio would grow strongly in future years.

Federal support for R&D is projected to increase from $103.2 billion in FY 2002 to $122.1 billion in FY 2007, an 8.1 percent increase after adjusting for expected inflation (see Table I-11). The nondefense R&D portion would climb 8.2 percent over the time period. As shown in Figure 2, the Bush Administration would fulfill a campaign pledge to complete the doubling of the NIH budget between FY 1998 and FY 2003; although NIH funding would only stay even with inflation thereafter, the large increase in FY 2003 would allow NIH R&D to increase 15.9 percent ahead of inflation between FY 2002 and FY 2007. Excluding NIH, however, nondefense R&D would just stay ahead of inflation with a 1.6 percent gain in inflation-adjusted terms over this time period.

Figure 2. Projected Nondefense R&D in the President's FY 2003 Budget, FY 2002-2007



Source: AAAS analysis *Projected Effects of the President's FY 2003 Budget on Federal R&D*

Included in the budget projections are a few increases.[1] NASA R&D would increase from $10.2 billion in FY 2002 to $12.2 billion in FY 2007 (up 9.3 percent after inflation; see Figure 2). The increase is even larger for key R&D programs because the International Space Station would see its R&D budget nearly halved over the next five years as development and construction wind down, leaving more room for other programs. NASA plans a dramatic expansion of the Space Science program from $2.9 billion in FY 2002 to $4.5 billion in FY 2007 (up 43.9 percent after inflation). NASA Aero-Space Technology would jump from $2.5 billion to $3.6 billion (up 28.9 percent after inflation) because of efforts to develop a new generation of reusable launch vehicles. Other programs slated for increases include intramural research in NIST, up 23.7 percent after inflation; NSF R&D (up 3.4 percent); and VA R&D on medical topics (up 6.1 percent).

Most other programs' projections generally show modest cuts over the next few years, or a gradual loss of purchasing power to inflation. Some programs would face steep cuts over the next several years, mostly in DOE: energy supply R&D (down 5.2 percent from FY 2002 to FY 2007), fossil energy R&D (down 17.4 percent), and energy conservation R&D (down 11.0 percent) would all fall steeply. The U.S. Geological Survey (USGS) would also lose ground to inflation and see its R&D budget fall 7.5 percent.

Projections, of course, are always wrong. They are not predictions. The FY 2003 appropriations process is just now getting under way in a Congress with different priorities than the President, especially the Democratic-controlled Senate, and future appropriations will be decided one year at a time. At best, projections are statements of one Administration's current priorities, and priorities always change in the give-and-take process of federal policymaking; nevertheless, they illuminate this Administration's future plans of plenty for DOD and NASA, and relative austerity for most other agencies, even NIH after the doubling process is complete.

[1] For a program-by-program look at the outyear projections, please see the detailed analysis of projected R&D, available on the AAAS Web site at http://www.aaas.org/spp/R&D in the "Guide to R&D Funding Data - Outyear Projections" section.

THE "FEDERAL SCIENCE AND TECHNOLOGY (FS&T)" BUDGET

Last year, the Office of Management and Budget (OMB) introduced a new "Federal Science and Technology" (FS&T) budget in the FY 2002 budget, and continues to push this concept in the FY 2003 budget (see Table I-7). The **FS&T budget** is successor to the Clinton Administration's "21st Century Research Fund" (see previous editions of this report) and contains most of the same programs. FS&T is a collection of selected R&D and non-R&D programs that emphasize basic and applied research and the creation of new knowledge or technologies. It also includes some S&T education and training activities but excludes most development, and is designed to be an alternative measure for the federal investment in science and technology and an alternative way to track federal S&T investments in the budget process. (This FS&T budget has a similar emphasis but different definitions from the FS&T concept proposed in 1995 by the National Academy of Sciences (NAS) as a subset of federal R&D; thus, the data in Table I-7 differ from NAS discussions of its version of FS&T in previous editions of this report.)

FS&T would increase 8.9 percent to $57.0 billion in FY 2003, with a mixed bag of increases and decreases skewed toward the positive by the large increase for NIH.