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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 2006; "FS&T" Budget)

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HIGHLIGHTS

- The Bush Administration would place a high priority on **defense R&D and health R&D**. Defense R&D (up 8.0 percent to $49.4 billion) and health R&D (up 12.4 percent to $24.2 billion) would together make up more than three-quarters of the federal R&D portfolio. R&D funding for most other **national missions** would decline (see Table I-4).

- The federal investment in **basic research** would grow by 6.0 percent or $1.3 billion to an all-time high of $23.3 billion, primarily because of a 12.4 percent requested increase for basic research at the National Institutes of Health (NIH). Basic research excluding NIH would decline 1.0 percent to $10.4 billion. The total **federal investment in research** (basic and applied) would increase 5.4 percent to $45.8 billion, but excluding a large increase for NIH all other federal research would fall 0.7 percent to $23.8 billion (see Table II-1).

- The most recent data show that **R&D performed at colleges and universities** increased 6.4 percent to $27.5 billion in FY 1999, with similar or larger increases expected in more recent years (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 the National Institutes of Health (NIH).

- The AAAS analysis of the **outyear projections in the FY 2002 budget** shows that nondefense R&D would increase from $45.1 billion in FY 2001 to $55.5 billion in FY 2006, a gain of 10.9

percent after adjusting for expected inflation (see Table I-15). NIH would be responsible for the increase; excluding NIH, nondefense R&D would fall 2.8 percent in inflation-adjusted terms between FY 2001 and FY 2006. Most nondefense R&D agencies would see their R&D funding lose ground to inflation.

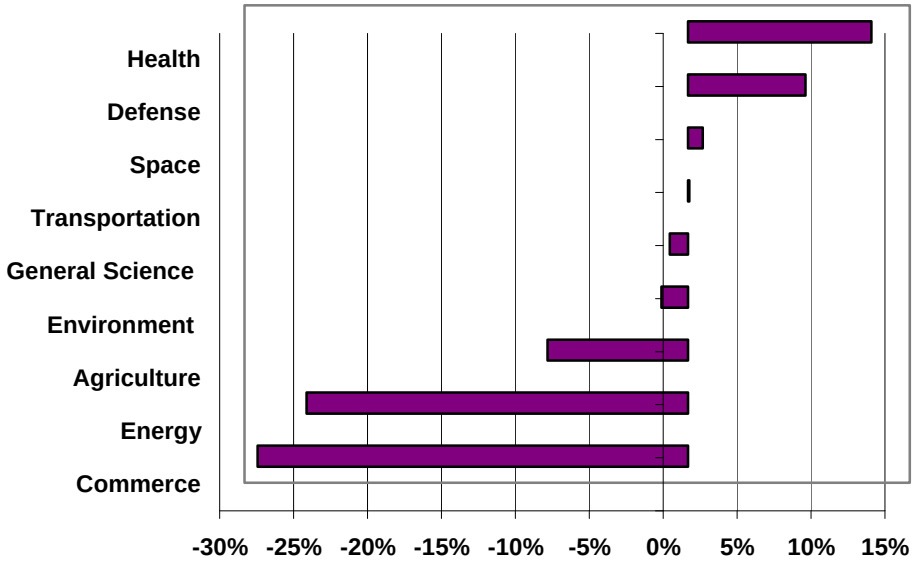
- The **"Federal Science and Technology (FS&T)" budget** is a collection of selected R&D and non-R&D programs that emphasize basic and applied research and the creation of new knowledge or technologies. The Office of Management and Budget (OMB) has introduced the FS&T budget as a successor to the Clinton Administration's "21st Century Research Fund." The FS&T budget would increase 5.3 percent to $49.7 billion in FY 2002, but would fall 0.9 percent without NIH (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 2002 budget. (Chapter 1 discusses historical trends in the functional distribution of federal R&D.)

The Bush Administration would place a high priority on defense R&D and health R&D. Both defense R&D (up 8.0 percent to $49.4 billion) and health R&D (up 12.4 percent to $24.2 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 2002 R&D Request by Mission
Percent Change from FY 2001



Source: AAAS, based on OMB R&D Budget Data and agency estimates for FY 2002.

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. In the Clinton Administration's FY 2001 request, nondefense R&D would have exceeded defense R&D for the first time since the Carter Administration, but fell slightly short of parity in FY 2001 appropriations.

The Bush Administration would widen the gap between defense and nondefense by aggressively expanding defense R&D investments to fulfill a campaign promise. DOD did not submit a full FY 2002 budget request in April; the agency is conducting a major review of defense priorities that will result in a full FY 2002 budget request after this book goes to press. Most of the DOD request consists of placeholder figures assuming the FY 2001 budget plus inflation, but there is also a request for an extra $2.6 billion in unallocated funds for development (see Chapter 6 for more on DOD), which accounts for most of the defense increase. There is a strong possibility that the DOD request will be even larger after the defense review is completed; most of the $2.6 billion will presumably go toward development of a national missile defense system.

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 $24.2 billion in FY 2002, an increase of $2.7 billion or 12.4 percent, mostly for R&D at NIH 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' medical and prosthetic research program. Health R&D would make up more than half the nondefense R&D portfolio and 25 percent of the total R&D portfolio, reflecting consistent growth in NIH's budget over the past few decades.

R&D funding for most of the other national missions would decline (see Figure 1). There would be steep cuts to energy (270) R&D (down 25.8 percent to $994 million), commerce (370) R&D (down 29.1 percent to $337 million), and agriculture (350) R&D (down 9.5 percent to $1.6 billion). Although energy is a high priority for the Bush Administration, and is the subject of a major vice-presidential review of government policy, the Administration focus for energy policy is heavily oriented

toward opening up new fossil or nuclear energy sources, with government R&D playing a smaller role than in the previous Administration. The Bush Administration has stated that R&D on energy technologies should be funded primarily by the private sector rather than the federal government. Similarly, the Administration would all but terminate the Advanced Technology Program, a major component of commerce R&D, because of its skepticism of industry-performed R&D that could possibly be funded by the private sector out of its own funds. Agriculture R&D would decline primarily because the Administration would not renew more than $100 million in congressionally designated research projects, while holding funding for formula and competitive research programs steady.

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 6.0 percent or $1.3 billion to an all-time high of $23.3 billion in the Bush budget, primarily because of a 12.4 percent requested increase for basic research in NIH. NIH would provide the majority (56 percent) of federal basic research. Although other agencies have enjoyed increases for their basic research programs in the last few years, basic research excluding NIH would decline 1.0 percent to $10.4 billion in FY 2002.

The total federal investment in research (basic and applied research) would increase 5.4 percent to $45.8 billion (see Table II-1), but excluding a large increase for NIH all other federal research would fall 0.7 percent to $23.8 billion. Development would increase 7.5 percent to $45.6 billion in FY 2002, primarily because of an unallocated $2.6 billion in new funds for DOD development included as a placeholder in the FY 2002 budget;

the proposed increase for DOD development could go even higher after completion of the defense strategy review.

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 84 percent of the FY 2002 total, while applied research would be 12 percent and basic research would be only 3 percent. In nondefense R&D, by contrast, basic research would be the largest category at 47 percent, with development at only 9 percent and applied research at 35 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 9 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 47 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 24 percent in FY 2002.

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 ($2.0 billion in FY 1999), 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 (57 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 16 percent and 10 percent, respectively, of the total university R&D portfolio.

OUTYEAR PROJECTIONS FOR FEDERAL R&D TO FY 2006

The FY 2002 budget also contains detailed projections for nondefense federal spending to FY 2006. (Detailed defense projections will not be available until completion of the Defense Strategy Review.) Although these projections are mostly mere extrapolations of current policies, they are a statement of the Bush Administration's priorities and their implications for the future. The AAAS analysis of these outyear projections reveals that the Bush budget would hold most discretionary programs to at best inflationary growth over the next several years; most R&D programs would fall behind expected inflation and see real losses in the longer term while entitlement programs, annual revenue losses from tax cuts, defense spending, and debt reduction would all increase over the next several years.

Federal support for nondefense R&D is projected to increase from $45.1 billion in FY 2001 to $55.5 billion in FY 2006, a 10.9 percent increase after adjusting for expected inflation (see Table I-15). 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 increases in FY 2002 and FY 2003 would allow NIH R&D to increase 28.4 percent ahead of inflation between FY 2001 and FY 2006. Excluding NIH, however, nondefense R&D would fall 2.8 percent in inflation-adjusted terms over this time period. Most nondefense R&D agencies,

with the exception of NASA and NIH, would see their R&D funding lose ground to inflation, mostly through cuts in FY 2002 and steady funding thereafter.

Included in the budget projections are a few increases.[1] NASA R&D would increase from $9.9 billion in FY 2001 to $11.4 billion in FY 2006 (up 3.4 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 $2.6 billion in FY 2001 to $4.0 billion in FY 2006 (up 37.6 percent after inflation). NASA Aero-Space Technology would jump from $2.2 billion to $3.4 billion (up 38.5 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 7.2 percent after inflation; NOAA R&D (up 4.3 percent); and DOT highway R&D (up 11.1 percent).

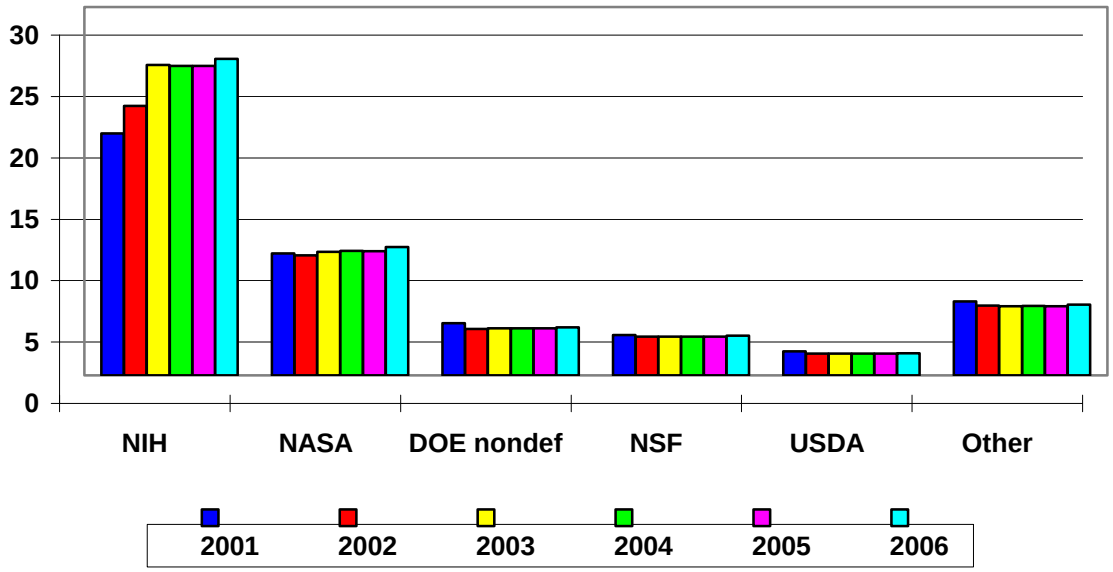
Most other programs' projections generally show cuts in FY 2002 and increases at the rate of inflation thereafter. NSF's R&D would fall in FY 2002 but would keep pace with inflation thereafter to end up 3.1 percent below the FY 2001 level after adjusting for inflation. Some programs would face steep cuts over the next several years, mostly in DOE: energy supply R&D (down 31.5 percent from FY 2001 to FY 2006), fossil energy R&D (down 26.5 percent), and energy conservation R&D (down 19.0 percent) would all fall steeply.

Projections, of course, are always wrong. They are not predictions. The FY 2002 appropriations process is just now getting under way in a Congress with slightly different priorities than the President, 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. The FY

[1] For a program-by-program look at the outyear projections, please see the detailed analysis of projected nondefense 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. When defense projections become available, the analysis of projected defense R&D will also be available there.

Figure 2. Projected Nondefense R&D in the President's FY 2002 Budget, FY 2001-2006

budget authority in billions of constant FY 2001 dollars



Source: AAAS analysis *Projected Effects of the President's FY 2002 Budget on Federal R&D*

2002 budget shows the importance the Administration assigns to defense spending and health spending, but other discretionary programs would be squeezed by higher priorities, including large tax cuts and debt reduction. As a result, most federal R&D agencies would not share in the burgeoning surpluses projected for future years.

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

The Office of Management and Budget (OMB) has introduced a new "Federal Science and Technology" (FS&T) budget in the FY 2002 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. (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 5.3 percent to $49.7 billion in FY 2002, but would fall 0.9 percent without NIH, consistent with trends in other measures such as total R&D, nondefense R&D, and total federal research.