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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 2005)

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HIGHLIGHTS

- **Nondefense R&D** in FY 2001 would exceed defense R&D for the first time since the Carter Administration, which would fulfill a Clinton Administration goal. Nondefense R&D would increase by 6.6 percent to $43.4 billion, or 50.9 percent of total R&D (see Table I-4). Although spending on military weapons and personnel would increase, **defense R&D** would fall 1.4 percent to $42.0 billion. Because of the Administration's interest in promoting a more balanced research portfolio, R&D in nearly every functional category would receive an increase, with an especially high priority for general science R&D (up 16.3 percent to $6.4 billion).

- **Basic research** continues to be a high priority for the Clinton Administration. The FY 2001 total of $20.3 billion, an increase of 6.8 percent, would follow an even larger increase of $1.5 billion in FY 2000 appropriations (see Table II-1). Basic research funding would increase significantly at the National Science Foundation (NSF; up 19.9 percent).

- Because of large R&D increases for the National Institutes of Health (NIH) and NSF, the two largest federal sponsors of academic R&D, **federal support of R&D at colleges and universities** would increase 7.6 percent to $18.1 billion (see Table I-7). NSF proposes to increase its support of academic R&D by 21.4 percent to $2.8 billion.

- The AAAS analysis of the **outyear projections in the FY 2001 budget** shows that nondefense R&D would increase from $40.8 billion in FY 2000 to $46.5 billion in FY 2005, a gain of 3.4 percent after adjusting for expected inflation (see Table I-15). Defense R&D would fall 13.7 percent in inflation-adjusted terms, even as total defense spending would rise.

R&D BY NATIONAL MISSIONS (BUDGET FUNCTIONS)

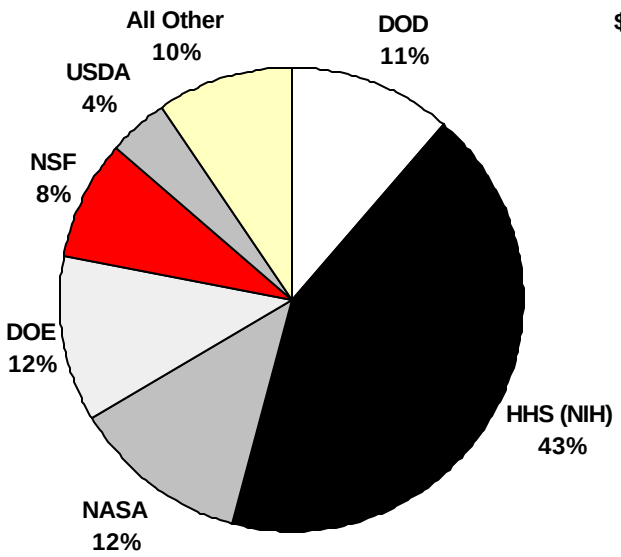
The federal government divides the budget into 20 "functional" groupings to illustrate national priorities. (AAAS separates the general science, space, and technology function into its subfunctions of General Science and Space.) The congressional budget resolution divides the total budget "pie" into 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 2001 budget. (Chapter 1 discusses historical trends in the functional distribution of federal R&D.)

Defense 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. However, in the FY 2001 request, nondefense R&D would exceed defense R&D for the first time since the Carter Administration. Nondefense R&D would increase by 6.6 percent to $43.4 billion, 50.9 percent of the total. Defense R&D, however, would fall $602 million or 1.4 percent to $42.0 billion, 49.1 percent of total R&D. The Clinton Administration requested a similar balance between defense and nondefense R&D in last year's request, but Congress boosted defense R&D far above the request while also giving increases to nondefense R&D. The net result is that defense R&D exceeds nondefense R&D in FY 2000.

In **nondefense** R&D, nearly all mission areas would receive increases in FY 2001, as a result of a general emphasis on science and technology in the budget and the stated Clinton Administration aim to produce a more balanced research portfolio of increases distributed across the breadth of federal R&D programs.

Figure 1. Total RESEARCH by Agency
FY 2001 President's Budget

TOTAL Research (basic + applied) = $38.6 billion



* - includes natural resources R&D.

Source: AAAS, based on OMB and agency budget data.

Despite the call for a balanced portfolio, **health R&D** would continue to be the dominant mission on the nondefense side. Health-related R&D would total $19.7 billion in FY 2001, an increase of $1.1 billion or 5.8 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-related R&D would make up nearly half the nondefense R&D portfolio and 23 percent of the total R&D portfolio, reflecting consistent growth in NIH's budget over the past few decades.

Consistent with the theme of a balanced portfolio across the breadth of science and engineering, the largest percentage increase in R&D among missions would be for **general science** R&D, which is R&D that the government funds not for any particular, immediate national need but rather for science or knowledge's sake. Although economic payoffs are expected eventually for general science R&D, the primary purpose of this funding is to foster and sustain a healthy, world-class U.S. science and engineering enterprise across the entire spectrum of science and engineering disciplines. Because of the mission-oriented nature of most R&D in the U.S. government, only two components of the U.S. R&D structure fund general science R&D: the National Science Foundation (NSF) and the Science account in the Department of Energy (DOE). General science R&D would increase $899 million or 16.3 percent in FY 2001 to $6.4 billion because of an unprecedented 19.8 percent requested increase for R&D in NSF (to $3.4 billion), and a smaller but still substantial 12.6 percent requested increase for DOE Science R&D (to $3.0 billion). (Please see Chapter 9 for information on NSF and Chapter 11 for information on DOE.)

Among the other functional areas of R&D, all but one would receive at least modest increases. The only functional area to receive less in FY 2001 would be **international** R&D, down $28 million to $114 million.

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' classifications of 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 be a high priority in the FY 2001 budget, climbing $1.3 billion or 6.8 percent to $20.3 billion. Basic research funding would increase significantly at NSF (up 19.9 percent), Commerce (up 31.1 percent), and DOE (up 6.2 percent). Applied research would increase by 4.4 percent to $18.4 billion; development would fall by 0.1 percent because of cuts in DOD's development work, although it would still account for the majority of federal R&D at $44.3 billion.

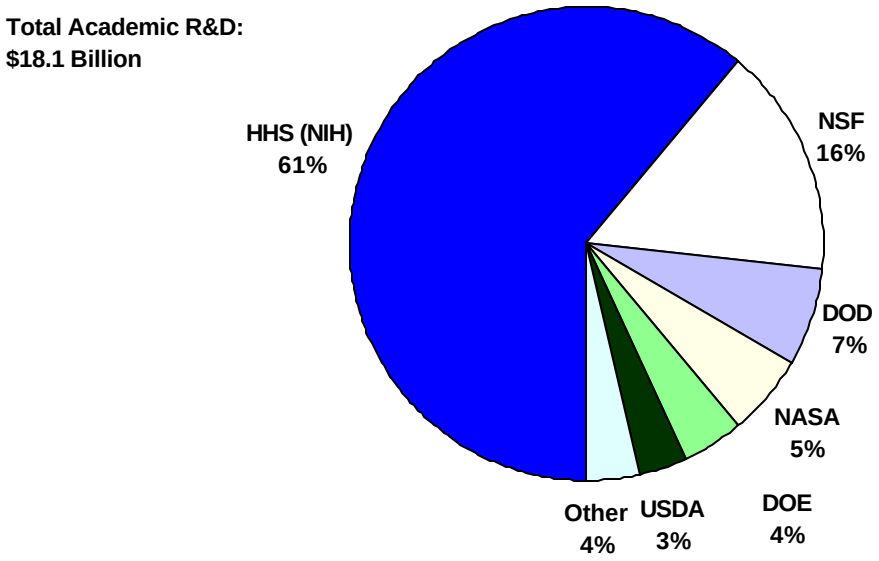
The character of work is quite different in defense and nondefense R&D, a point illustrated in Table I-6. Development would be by far the largest component of defense R&D, accounting for 84 percent of the FY 2001 total, while applied research would be 12 percent and basic research would be only 3 percent. In nondefense R&D, by contrast, basic research would be the largest category at 44 percent, with development at 21 percent and applied research at 31 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.

Because of the expensive development costs of DOD weapons systems, the federal R&D portfolio looks dramatically different if only basic and applied research are considered, and development and R&D facilities are excluded. Figure 1 and page 148 of Table II-1 show that when only research is considered, DOD is no longer the dominant federal agency supporter. The Department of Health and Human Services (HHS; mostly NIH) becomes the largest federal supporter of research, with $16.5 billion out of a $38.6 billion portfolio in FY 2001.

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 the majority of federally funded basic research and is

Figure 2. Federal R&D in Colleges and Universities (FY 2001 Budget)



Source: AAAS, based on OMB R&D budget data for FY 2001 and agency budget justifications.

also responsible for the training of future scientists and engineers. As shown in Table I-8, 59 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 ($1.9 billion in FY 1998), although industry support for academic R&D is growing rapidly.

Table I-7 shows agencies' estimates for their support of R&D in colleges and universities, most of which is for basic research. Total federal support of academic R&D is expected to increase substantially by 7.6 percent to $18.1 billion because of a strong emphasis on basic research in the request and because of large R&D increases for NSF and NIH, the two largest federal sponsors of academic R&D (see Figure 2). NIH, which is responsible for 61 percent of all federal support of academic R&D and concentrates its support on the life sciences, would fund $10.9 billion of academic R&D in FY 2001 (up 6.1 percent). NSF, the next largest federal sponsor with 16 percent of the federal total, would boost its support by a staggering 21.4 percent to $2.8 billion, which could have a wider impact than NIH's larger dollar increase because NSF is the dominant sponsor of academic R&D in most non-life sciences disciplines. Most other agencies would also increase their support of academic R&D.

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. (For more information on historical trends in academic R&D, please see Chapter 2.)

OUTYEAR PROJECTIONS FOR FEDERAL R&D TO FY 2005

The FY 2001 budget also contains detailed projections for federal spending to FY 2005. Although these projections are only extrapolations of current policies, they are a statement of current Administration priorities and their implications for the future. The AAAS analysis of

these outyear projections reveals that, because of the expectation of growing surpluses and a decision to use some of these surpluses for additional discretionary spending, the Clinton Administration is anticipating real increases for most nondefense R&D programs to FY 2005. By contrast, last year's budget projected declines in most R&D programs.

Federal support for R&D is projected to increase from $83.3 billion in FY 2000 to $87.1 billion in FY 2005, which becomes a decline of 5.3 percent after adjusting for expected inflation (see Table I-15). The overall decline is due to projected cuts in defense R&D over the next five years. By FY 2005, defense R&D would fall 13.7 percent in inflation-adjusted terms even as total defense spending would rise, consistent with past Clinton Administration budgets which also called for declining defense R&D.

Nondefense R&D, however, would increase under the President's proposals from $40.8 billion in FY 2000 to $46.5 billion in FY 2005, a gain of 14.2 percent. After adjusting for expected inflation, the five-year gain becomes 3.4 percent in contrast to a projected 6.7 percent cut over five years in last year's budget.

To understand these projections, one must view them in the context of the entire federal budget.[1] Nearly all federal R&D is funded through the discretionary one-third of the budget subject to annual appropriations. The FY 2001 budget proposes to increase total discretionary spending by 5.2 percent in FY 2001 and at a rate high enough to keep pace with expected inflation thereafter, from $592 billion in FY 2000 to $668 billion in FY 2005, a 2.2 percent inflation-adjusted increase.

These projected increases are a marked improvement from last year's budget projections because for the past several years, the Administration's proposals were constrained by discretionary spending caps enacted in 1997 that mandate tight restrictions on discretionary spending. The caps are law until FY 2002, but this year instead of maneuvering to fit his discretionary proposals under them the President's

[1] For a more detailed discussion of the outyear projections for R&D in the context of the larger federal budget, please see the "AAAS Analysis of Outyear Projections for Federal R&D in the FY 2001 Budget," available on the AAAS Web site at http://www.aaas.org/spp/R&D in the "FY 2001 R&D" section.

budget proposes new discretionary spending caps that would provide room for his discretionary proposals. Although increases in defense spending would be reserved for non-R&D programs, on the nondefense side R&D programs would share in the overall increases.

Included in these projections are some surprising increases for agencies and programs long accustomed to declining outyear budgets.[2] NASA R&D would increase from $9.8 billion in FY 2000 to $11.5 billion in FY 2005 (up 6.1 percent after inflation). The increase is even larger for key R&D programs because the International Space Station would see its R&D budget halved over the next five years as development and construction are completed, leaving more room for other programs. NASA plans a dramatic expansion of the Space Science program from $2.2 billion in FY 2000 to $3.6 billion in FY 2005 (47.8 percent after inflation), including a full complement of Mars exploration missions. NASA R&D in Aero-Space Technology would double from $1.1 billion to $2.3 billion (up 85.4 percent after inflation) because of accelerated efforts to develop a new generation of reusable launch vehicles. Other programs slated for dramatic increases include: Industrial Technology Services in the National Institute for Standards and Technology (NIST; up 60.8 percent after inflation) because of a new Institute for Information Infrastructure Protection and increases for the Advanced Technology Program; and DOE's Energy Supply R&D (up 23.3 percent after inflation) for solar, renewable, and nuclear energy R&D.

Most other programs' projections generally show growth in FY 2001 and smaller increases at the rate of inflation thereafter, consistent with the pattern for discretionary spending as a whole. NSF's R&D would jump by almost 20 percent in FY 2001 but would increase only slightly thereafter to end up 15 percent above the FY 2000 level after adjusting for inflation. NIH R&D would increase by nearly $1 billion between FY 2000 and FY 2001 but would take four years to increase by another $1 billion, for a five-year increase of 1.6 percent after inflation.

[2] For a program-by-program look at the outyear projections, please see the detailed analyses of projected defense R&D and 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" section.

In contrast to projected cuts for most R&D programs in past budgets, only a few are projected to decline in the FY 2001 budget. USDA R&D would decline 6.1 percent after inflation because a $120 million a year mandatory competitive grants program would expire before FY 2005, offsetting projected increases for appropriated R&D programs. NOAA's R&D would decline 3.9 percent over five years because modest increases in the budget would fail to keep pace with inflation; NASA's Earth Science program budget would fall by 18.0 percent after inflation because money would flow toward other NASA priorities.

For defense R&D, the long post-Cold War slide in R&D funding is projected to continue. DOD's priorities for the next few years include military personnel pay, operational readiness, and procurement of new weapons systems. All are projected to receive inflation-adjusted increases over the next five years. While DOD's basic research (down 5.8 percent) and applied research (down 11.3 percent) programs would fare somewhat better than its development programs, total DOD R&D would fall 14.6 percent after inflation to $37.0 billion. DOE's defense R&D would also decline by 2.8 percent after inflation. While DOE's nuclear weapons R&D in Weapons Activities would see increases from $2.2 billion to $2.4 billion, the increases would fail to keep pace with inflation, resulting in a 0.8 percent cut by FY 2005 in real terms.

Projections, of course, are always wrong. They are not predictions. The FY 2001 appropriations process is just now getting under way in a Congress with 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. They are especially likely to change by next year, when a new President will submit a budget reflecting a new set of priorities. The FY 2001 budget shows that the importance the Administration assigns to defense spending and domestic discretionary spending is higher than in past years, and that favorable budget surplus projections make increased spending in these areas possible while still fulfilling the Administration's promises to boost Medicare, cut taxes, and pay down the national debt. As a result, federal R&D investments have room to grow in FY 2001 and future years.