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Federal Research and Development: Budgeting and Priority-Setting Issues, 108th Congress

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SUMMARY

Federal R&D funding priorities change over time, reflecting Presidential and national preferences. Defense R&D predominated in the 1980s, decreasing to about 50% of federal R&D in the 1990s. In nondefense R&D, space R&D was important in the 1960s as the nation sought to compete with the Soviet Union; energy R&D was a priority during the energy-short 1970s, and, since the 1980s, health R&D has predominated in civilian science. Defense R&D has re-emerged to support the war against terrorism.

Except for the Departments of Homeland Security (DHS) and Defense (DOD), FY2005 R&D appropriations were funded by H.R. 4818, an omnibus bill, signed on November 20. The President's FY2005 R&D request totaled about $131.7 billion, about 4.7% more than the FY2004 appropriated level. Pressures on the discretionary budget have increased; final R&D appropriations totaled about $132.2 billion, about 80% of which was for defense R&D. Non-defense R&D increased about 2.1%. The largest increases went to R&D in DHS, DOD, Agriculture, Commerce, and Transportation; smaller increases were made for R&D in the Department of Energy and for the National Aeronautics and Space Administration and the National Institutes of Health. The National Science Foundation's budget was cut by about 0.3% from the FY2004 level. R&D was also reduced from the FY2004 level for the Department of Education and the Environmental Protection Agency.

For FY2004, appropriations were enacted only for DOD, DHS, and for the Legislative Branch. That funding together with funding appropriated in the omnibus appropriations bill, P.L. 108-199, effectively increased R&D funding to about $127.0 billion, or by 8% over FY2003, with 93% of the increase going to DOD, DHS, and NIH. Other agencies had only modest increases or cuts.

National R&D funding continues to grow, but the federal R&D share has declined to less than 30% of the total. Debates focus on which fields of federal R&D should be increased and how to set priorities and to "balance" health and nonhealth fields.

Legislative priority-setting initiatives include bills to make permanent the research and experimentation credit (H.R. 428, H.R. 463, H.R. 2896, S. 664, S. 1475, and S. 1637).

The Administration included in its request a "Federal S&T" budget, which may presage a future unified science and technology (S&T) budget. The FY2005 budget requested funding for three interagency R&D initiatives: networking and information technology; climate change science; and nanotechnology. Other proposals to coordinate R&D include a continuing priority-setting mechanism; a cabinet-level S&T body; functional R&D budgeting; and reestablishment of a technology assessment function (H.R. 125, H.R. 4755, H.R. 4670, and S. 2556). The Administration opposes earmarking for R&D, which AAAS estimated totaled about $2.1 billion for FY2005, because the practice distorts agency priorities. The Administration has started using some performance measures for R&D budgeting, using tools of - the Government Performance and Results Act (GPRA) and the Program Assessment Rating Tool (PART). Critics say better data and concepts are needed to use performance budgeting for basic and applied research.

MOST RECENT DEVELOPMENTS

Except for the Departments of Homeland Security (DHS) and Defense (DOD), FY2005 R&D appropriations were funded by H.R. 4818, an omnibus bill, signed on November 20. Pressures on the discretionary budget have increased; final R&D appropriations totaled about $132.2 billion, about 80% of which was for defense R&D. Non-defense R&D increased about 2.1%. The largest increases went to R&D in DHS, DOD, Agriculture (USDA), Commerce (DOC), and Transportation (DOT); smaller increases were made for R&D in the Department of Energy (DOE) and for the National Aeronautics and Space Administration (NASA) and the National Institutes of Health (NIH). The National Science Foundation's (NSF) budget was cut by about 0.3% from the FY2004 level. R&D was also reduced from the FY2004 level for the Department of Education (DOEd) and the Environmental Protection Agency (EPA).

BACKGROUND AND ANALYSIS

Federal R&D funding priorities shifted over time, reflecting Presidential preferences and national priorities. Defense R&D predominated in the 1980s but decreased to about 50% of total federal R&D in the 1990s, reflecting the Clinton Administration policy. In nondefense R&D, space R&D was important in the 1960s as the nation sought to meet Presidential pronouncements and to compete with the Soviet Union in the space race; energy R&D joined space as a priority during the 1970s; and since the 1980s, health R&D funding has grown as the cohort of aged population increases and the promise of life sciences and biotechnology affects national expectations. Defense and counterterrorism R&D funding were increased in this budget cycle. (See also CRS Report RL30905, *Federal Research and Development: Budgeting and Priority-Setting, 1993-2000*.)

FY2003 Budget Action

The President's R&D request totaled about $112.0 billion, about 8% more than the appropriated level for FY2002. Similar to the pattern for FY2002, the increases proposed for DOD R&D, at 11% more than FY2002, and for NIH, at about 16% more, dominated, leaving all the other R&D funding agencies combined with less money than in FY2002.[1] Total defense R&D funding, spurred in part by anti-terrorist priorities, for DOD and DOE's military/nuclear programs, would have increased by almost 10%. As a result, while overall discretionary spending (from which most all R&D is funded) would rise almost 7% over FY2002, total non-defense, non-NIH R&D funding would decline or be flat. Congressional action funded R&D at about $117.0 billion. Although civilian agencies' budgets were cut 0.65% for most domestic programs, appropriations were increased significantly for R&D in DOD (+18%), NIH (+15.5%), DHS (+66%), and NSF (+11.4%). Other R&D programs were increased modestly, except for DOT, which was reduced.

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[1] AAAS, "Bush Proposes Large Increase for DOD, NIH R&D: Mix of Cuts and Increases for Other R&D Programs," Feb. 8, 2002.

FY2004 Budget

The President's FY2004 R&D request totaled about $122.3 billion, about 4.4% more than the FY2003 appropriated level. Similar to the FY2003 funding pattern, counter-terrorism spurred increases in DOD R&D, at 7.1% more than FY2003, and in DHS, at about $1.0 billion, or almost 50% more than FY2003. NIH's increase was 2.7% more than FY2003; NSF's budget request at 2.8% over FY2003 fell short of the 15% envisioned in 2002 legislation authorizing NSF's budget to double over five years. In DOC, the President sought to eliminate the Advanced Technology Program (ATP), and the Manufacturing Extension Partnership (MEP). The budget resolution conference agreement for function 250, general science space and technology, included an increase of $324.0 million above the request for NSF research activities and $100.0 million more than requested for DOE science programs. Separate appropriations were enacted for DOD, DHS, and for the Legislative Branch, and, together with an omnibus appropriations bill, P.L. 108-199, they increased R&D funding to about $127.0 billion, or by 8.1% over FY2003, with 93% of the increase going to DOD, DHS, and NIH. DOD's R&D funding was increased by 12.4% over FY2003, largely for development programs, while basic research funding was decreased. Other agencies had modest increases or cuts. NSF's R&D budget increased by 4.7%; and DOE's by 6.1%. Reductions were made in R&D at USDA (-4.9%) and at DOT (-8.2%). NIST's R&D budget was cut 3.9%, with a 0.9% cut in ATP. **See Table 3.**

FY2005 Budget

R&D budgets are developed over an 18-month period before a fiscal year begins. Often advisory committees, influenced by professional scientific groups, recommend R&D priorities to agencies, which use this information, internally generated information, and the White House's Office of Management and Budget (OMB) and Office of Science and Technology Policy (OSTP) guidance to determine priorities. Agencies and OMB negotiate funding request levels during the preparation of the budget before it is sent to Congress. After standing committees recommend budget levels for matters within their jurisdiction to the budget committees, Congress passes a budget resolution, which sets spending levels and recommends levels for each budget function that appropriations committees use in setting discretionary (302b)spending allocations for each appropriations subcommittee. The resolution also gives outyear projections based on budget and economic assumptions. Each of the 13 appropriations subcommittees report approved funding levels for agencies within their jurisdiction; appropriations bills, which give agencies spending authority, are sent to the floor, usually beginning in the summer.

Except for the Departments of Homeland Security (DHS) and Defense (DOD), which were funded via the enactment of appropriations bills, FY2005 R&D funding was appropriated in H.R. 4818, an omnibus bill, signed on November 20. The President's FY20-05 R&D request totaled about $131.7 billion, about 4.7% more than the FY2004 appropriated level. Pressures on the discretionary budget have increased; final R&D appropriations totaled about $132.2 billion, about 80% of which was for defense R&D. Non-defense R&D increased about 2.1%. The largest increases went to R&D in DHS, DOD, USDA, DOC, and DOT; smaller increases were made for R&D in the Department of Energy and for NASA, and NIH. Legislation had been enacted in December 2002 to double NSF's

budget over five years (as had been done previously for NIH), but NSF's budget request at 3.6% over FY2004 fell short of the amount envisioned in the authorizing legislation and for FY2005, congressional action reduced NSF's budget was by about 0.3% from the FY2004 level. Congress also appropriated less than the FY2004 level for R&D in the Department of Education and the Environmental Protection Agency. In DOC, the President sought again to eliminate the ATP, funded at $171.0 million in FY2004, and would have reduced funding for MEP about 65%. Congress increased DOC R&D funding for NOAA (+10.7%) and funded ATP R&D at $110 million, about 23.8% less than in FY2004.

Overall, funding for federal R&D was increased by about 4.8%; with increases in development funding of 6.5%, applied research of 3.4%, and basic research of 1.5%, with reductions in basic research funding in NSF, NASA, Interior, and EPA. Funding for nanotechnology R&D, the Administration's priority interagency initiative, was requested to be increased by almost 14% to $982.0 million. Budget resolutions adopted in the House, H.Con.Res. 393, and the Senate, S.Con.Res. 95, increased defense and homeland security spending above the President's request, but limited growth in domestic discretionary spending to at or below the Administration's request. The Senate resolution added $1.3 billion for NIH funding. Outyear funding projections for the next five years show reductions, in terms of constant dollars, in all R&D outside of the priority areas of defense, homeland security and space. **See Table 3.**

Counterterrorism Funding

R&D to combat terrorism was requested to be increased from about $1.2 billion in FY2002 to almost $2.7 billion for FY2003, and $3.2 billion for FY2004. See **Table 1**. Comparable figures are not available for the FY2005 request. Unpublished OMB data on funding for homeland security R&D, which is a subset of counterterrorism, show a 5.4% increase from the enacted FY2004 level to $3.6 billion requested for FY2005. **See Table 2.** The largest FY2005 programs are in NIH largely for bioterrorism R&D and for construction of containment facilities; DHS's Science and Technology Directorate; DOD; NSF; and the Department of Justice. Other programs are in USDA, DOC's NIST; EPA; DOT; and DOE.

P.L. 107-296, the Homeland Security Act of 2002, consolidated some federal homeland security R&D programs in the new Department of Homeland Security (DHS). DHS's FY2004 R&D budget request was $907.0 million; Congress agreed to raise appropriations by about 16% to $1050.0 million. The FY2005 DHS R&D request was $ 1,141.0 million; and the appropriated amount was $1,243.0 million; about 29% of DHS's R&D will be for basic and applied research, up 114% since FY2004. For additional details, see CRS Report RS21270 and CRS Report RL31914; see CRS Report RL32481 and CRS Report RL32482, on homeland security R&D funding data quality issues.

Table 1. Research and Development to Combat Terrorism, by Agency, FY2000-FY2004 (Request)

(dollars in millions)

Agency	FY2000 Actual	FY2001 Actual	FY2002 Enacted	FY2002 Supple-mental	FY2003 Enacted	FY2003 Supple-mental	FY2004 Request
Agriculture	$37.3	$51.7	$28.0	$52.2	$30.4	— -	$42.1
Commerce	9.6	0	11.7	7.0	16.4	— -	19.4
Corps of Engineers - Civil Works	unknown	unknown	— -	3.0	— -	— -	— -
Defense	unknown	unknown	259.0	2.0	597.0	— -	157.0
Energy	59.7	66.2	64.9	19.0	19.0	— -	[43.7] (OMB FY2003 rept. p. 57)
EPA	unknown	0	2.8	1.5	49.7	— -	29.0
DHHS	109.7	102.8	117.2	85.0	831.2 [previous FY2003 data=1,770.9 (NIH, 1.75B; CDC, 40M; FDA, 50M]	— -	1648.2
Homeland Security	— -	— -	110.0	93.4	658.2	— -	844.0
Justice	45.2	11.4	13.1	76.1	173.5	4.9	174.7
NSF	unknown	7.0	7.0	0	27.0		
Postal Service	unknown	unknown	— -	9.5	— -	— -	— -
State	unknown	unknown	1.8	— -	1.8	— -	1.8
Transportation	50.7	50.2	54.7	54.0	3.7	— -	3.9
Treasury	2.1	1.2	1.1	0	1.1		unknown
Total	**$511.3**	**$589.4**	**$827.0**	**$383.6**	**$2,649.4**	**$4.9**	**$3,205.7**

Source: OMB, *Annual Report to Congress on Combating Terrorism, FY2002*, p. 27 for column "FY2000;" OMB, *Annual Report to Congress on Combating Terrorism, June 24, 2002*, p. 26, for column FY2001, DOE for FY2002, DHHS for FY2003, and Treasury. The rest is from OMB, *2003 Report to Congress on Combating Terrorism*, Sept. 2003, p. 16, available at [http://www.whitehouse.gov/omb/inforeg/2003_combat_terr.pdf].

Table 2. Homeland Security Research and Development Funding, by Agency, Budget Authority

(dollars in millions)

Agency	2003 Enacted	2003 Supplemental	2004 Enacted	2005 Budget Request
Agriculture	$11.8	— -	$21.8	$50.0
Commerce	16.4	— -	16.5	22.6
Defense	212.0	— -	267.0	340.2
Energy	18.9	— -	19.5	8.0
Health/Human Services	834.2	— -	1643.8	1557.2
Homeland Security	619.2	— -	959.2	1111.4
Justice	160.5	25.2	179.5	194.5
Transportation	3.7	— -	— -	4.1
EPA	52.9	— -	28.8	22.8
NSF	268.5	— -	305.6	315.8
Total, Homeland Security R&D	2198.2	25.2	3441.7	3626.6
Total, Non-defense Homeland Security R&D	**$1986.2**	**$25.2**	**$3174.7**	**$3286.4**

Source: Information Provided by OMB, Jan. 27, 2004. OMB characterized this data as "discretionary budgetary resources," which a staff member said was also "budget authority."

Priority-Setting Issues

Current priority-setting debates focus on the functions and size of federal R&D funding as a part of national R&D and on how to balance priorities in the portfolio of federal nondefense R&D, especially between health and nonhealth R&D.

Role of the Federal Government in Supporting R&D

A core issue is to reconcile the presumed benefits of R&D — the projected high rates of return to the economy and society from investments in R&D — with a FY2005 R&D budget request that focuses on defense, homeland security, and health R&D spending and level funding in most other areas. The benefits of R&D also need to be considered against long-term economic and budget projections of deficits, decreasing outyear federal R&D budgets, and reductions in domestic discretionary spending. President Bush's FY2002 budget said, "More than half of the Nation's economic productivity growth in the last 50 years is attributable to technological innovation and the science that supported it" (p. 29). In Spring 2000, President Clinton's Committee of Advisors on Science and Technology (PCAST), in *Wellspring of Prosperity*, described some of the payoffs from federal investments in R&D, which it said "underscores the need for sustained and cooperative support in the 21st century to avoid the dangers and seize the opportunities."[2]

Trends in Federal R&D Support. Given these assessments of the importance of federal R&D, a key priority-setting issue is how large should the federal R&D budget be in relation to its functions and the funding provided by such other R&D supporters as industry?

Federal R&D funding, while rising in terms of absolute (or nominal) dollars, is declining as a part of the national R&D total, which is estimated to have grown overall to $284.0 billion in FY2003, the latest year for which data are available. In constant 1996 dollars, total national R&D funding increased 44% between the years 1993 and 2003.[3] Industrial support for R&D increased 56% and federal government support increased 18%. OMB historical trend data indicate that R&D funding has declined from about 17% of total federal discretionary outlays in FY1965 to about 14% today. In part because of economic pressures and budgetary caps, during the years FY1994 to FY2000, federal R&D funding was below the previous constant-dollar high of FY1993. As a result of congressional action, constant-dollar R&D appropriations started to eclipse the FY1993 level beginning with FY2001. However, concerns that had been raised about the declines in federal R&D funding have not abated because of current projections of economic slowdown, spending to combat terrorism, and a return to deficit spending, which is reducing discretionary R&D spending.

Industry is the largest supporter and performer of national R&D, funding 63% of total R&D (the government funds 30%) and conducting 68% of the total. Most industrial R&D is for near-term applied work and product or prototype development. The government funds

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[2] See also: Steven Parson and John Jankowski, "Sixth Year of Unprecedented R&D Growth Expected in 2000," *NSF Data Brief*, Nov. 29, 2000, p. 1. NSF 01-310.

[3] Based on data in Brandon Shackelford, "U.S. R&D Projected to Have Grown Marginally in 2003," NSF InfoBrief, Feb. 2004, NSF 04-307 and NSF, Table 1B, *National Patterns of R&D Resources: 2002 Data Update* (current to October 2002).

about 10% of R&D performed by industry. Federal support for development, which totals about 44% of federal R&D, goes largely to industry and to defense R&D.[4] The federal government, in contrast to industry, focuses more on supporting basic research and academic R&D, which some call the "seed corn" of future scientific and technological development and economic growth. The federal government funds almost half of all national expenditures for long-term basic research (largely in universities and federal laboratories), while industry funds about 30%.[5] After industry, universities and colleges are the second-largest performer of national R&D, funded mostly by the federal government (56%). As for research per se, about 42% of federal research dollars go to universities and 24% to mission-oriented work in federal agency laboratories, largely at DOD, NIH, and USDA.

Observations and Recent Legislative Initiatives. The federal government is the major supporter of the nation's basic research, which generates much of the knowledge that industry uses for innovative R&D, and of university research. Some observers argue that federal research support should be funded at increasingly higher levels as a public good to enhance the U.S. ability to advance scientifically, technologically, and economically; to broaden the knowledge base that industry uses; and to train science and technology (S&T) personnel. Related issues are whether incentives should be increased for states[6] and industry to augment support of basic and academic research, or whether too much support from these sources would overwhelm academic research with pressure to conduct short-term applied studies.[7] Among the legislative options in this area is to make permanent the Research and Experimentation (R&E) tax credit that provides tax credits for industrially funded research in industry and universities and was due to expire on June 30, 2004.[8] The Administration sought to have it made permanent and estimated it would cost about $30.0 billion over the period 2005-2009. On October 4, 2004, President Bush signed into law a measure (H.R. 1308, P.L. 108-311) that included a provision extending the research tax credit through December 31, 2005. Other legislation was introduced on this topic.

Priorities Among Fields of Federally Funded Research

An important question is what should be the balance among fields of federally supported research, and specifically, since health/life sciences research has consistently received priority in the non-defense area, should more funding go to support other fields of

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[4] B. Shackelford, "Slowing R&D Growth Expected in 2002," *SRS Info Brief*, Dec. 2002, NSF 03-307; data on R&D funding by sector based primarily on NSF, *National Patterns of R&D Resources: 2000 Data Update.* See also, Ronald L. Meeks, "Federal Survey Shows Defense Funding of Industry Is Largest Share of Federal R&D in FY2000," NSF Data Brief, February 11, 2000, NSF 00-309.

[5] Expenditures do not equal outlays or budget authority. NSF, *National Patterns, 2000 Data Update. See also* Elisa Eiseman, Kei Koizumi, and Donna Fossum, *Federal Investment in R&D*, RAND, Sept. 2002, MR-1639.0-OSTP.

[6] The NAS held "Planning Meeting on the Role of State Funding of Research," July 13, 2001. See RAND/OSTP, *Discovery and Innovation: Federal R&D Activities in the Fifty States,* June 2000.

[7] NSTC, *Implementation of the NSTC Presidential Review Directive-4: Renewing the Federal Government-University Research Partnership....,* Jan. 2001.

[8] See CRS Report RL31181, *Research Tax Credit: Policy Issues for the 108th Congress*, by G. Guenther.

science? Some are concerned that the emphasis on health R&D may presage a scarcity of knowledge in physical sciences, math, and engineering.[9] Some observers maintain that funding should be increased for all R&D fields, and others cite the need to assess reallocating federal funding from health to nonhealth R&D. As shown in **Figure 1**, Health sciences R&D has grown as a priority for about 20 years. Over the period FY1995 to FY2005, requested, R&D funding at NIH increased 121% in constant dollars compared to DOD, 70%;NSF, 50%; USDA, 23%; DOE, 18%; and NASA, 1%. R&D funding was decreased in constant dollars for EPA and the Departments of the Interior, Transportation and Commerce. For FY2005, it is estimated that federally funded health-related R&D, primarily at NIH, would receive about 50% of the civilian R&D budget. In terms of funding by field, federal obligations for life sciences increased from $9.9 billion in FY1992 to $22.2 billion in FY2002 estimated, or about 125%, while at the same time, between those years funding for physical sciences increased 16%; mathematics and computer sciences, 125%; and engineering, 41%. (Based on NSF data and AAAS data.)

In 1998, the Senate passed S.Amdt. 2272 to S.Con.Res. 86, the approved Senate budget resolution. The amendment expressed the sense of the Senate that the NIH budget should double within the next five years. Beginning with FY1999, Congress started appropriating NIH funding at levels that would accomplish this task by 2003. The doubling is not yet complete in constant dollar terms; some say that because the FY2005 increase requested for NIH is small, at 2.7%, gains made in biomedical R&D will erode.

Congressional Views About the Balance in Federal R&D Funding. There are various perspectives on the issue of balance. In the House, the Science Committee, in views similar to last year, issued a press release February 11, 2004 in which "Members question the balance of the Administration's R&D budget, noting that non-defense, non-homeland security funding increased by only 2.3 percent. Further, most of that increase is for development (up to eight percent) while basic research is essentially flat-funded." Former Senate Budget Committee Chairman Domenici was reported to have said during a Senate Budget Committee hearing that " ... you can't increase one piece of science ... and leave the other kinds of research in the doldrums.... In about five years, you're going to have the medical scientists clamoring for where are the physical scientists, ... the people that work on the newest physics of machinery and engineers and nano-engines and the like?"[10] Senator Jeff Bingaman urged the President to develop a science and technology policy "to force the White House to give some thought and examination to the technological opportunities and revolutions facing us that we are about to miss."[11] Thirty-two Nobel laureates and industry executives wrote a letter to President Bush in April 2003, urging increased funding for physical sciences, mathematics and engineering in the 2005 budget.

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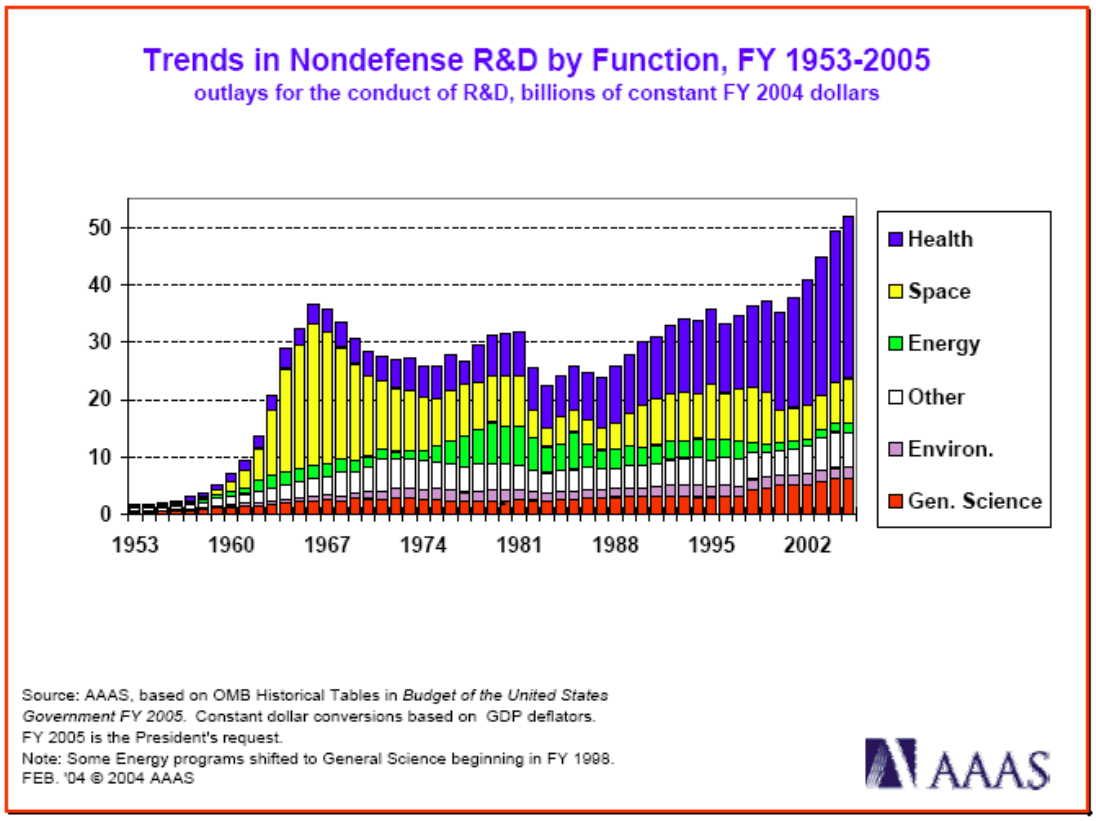
[9] In 2003, the National Science Board released a report assessing shortages in *The Science and Engineering Workforce/Realizing American's Potential,* NSB-03-69.

[10] Richard M. Jones, "Reaction to the FY2002 Bush Administration S&T Request," *AIP Bulletin of Science Policy News*, FYI #26, Mar. 7, 2001.

[11] "Bingaman: A Revitalized Science and Technology Policy Badly Needed," Press Release, Feb. 11, 2004, Office of Sen. Bingaman.

Figure 1. Trends in Nondefense R&D by Function, FY1953 to FY2005



Professional Groups' Views About Balance

Professional groups have recommended increasing both funding and balance in support among federally funded research fields. In one of the most recent analyses of this issued, the President's Council of Advisors on Science and Technology (PCAST) released *Assessing the U.S. R&D Investment*, January 2003. The draft of this report, which was issued in August 2002, called for doubling federal budgets for physical sciences and electrical, mechanical, chemical, and metallurgical and materials engineering, and endorsed doubling the NSF budget. Reportedly, the OSTP director objected to singling out any agency or field for doubling,[12] so the report recommended targeting physical sciences and engineering to bring "them collectively to parity with the life sciences over the next 4 budget cycles" in order to better balance budget allocations. The U.S. Commission on National Security 21st Century, in *Road Map for National Security: Imperative for Change, The Phase III Report ....*, 2001 concluded that threats to the nation's scientific and educational base are distinct new dangers to U.S. national security. It recommended doubling the federal R&D budget by 2010 to about $160.0 billion and improving the competitiveness of the less capable R&D institutions. A National Academy of Engineering report, *Trends in Federal Support of Research and Graduate Education*, 2001, recommended that the Administration and Congress should evaluate federal funding for research by field and assess its implications for knowledge

[12] "PCAST Releases Report on U.S. R&D Investment," *CFR Weekly 'Wrapup*, Feb. 14, 2003.

generation and industrial growth, and increase budgets for underfunded disciplines. *New Foundations for Growth: The U.S. Innovation System Today and Tomorrow,* released by the National Science and Technology Council on January 10, 2001, recommended funding across the portfolio because "[I]t's not possible to anticipate where exciting new developments will arise. Increased funding across a carefully constructed 'portfolio' of investments will help ensure the health of the national innovation system" (pp. 12-13). The Alliance for Science and Technology Research in America (ASTRA), reportedly modeled after Research! America, an advocacy group for medical research, focuses on physical sciences. Its goals are "To provide a strong, collaborative, political voice for math, physical sciences and engineering before the federal government that results in substantial and sustained investment; to promote strong, compelling, and mutually reinforcing messages across all groups lobbying for improved vitality of the U.S. research enterprise for those fields; and to nurture support for research for those fields among the voting public."[13]

An applications-oriented approach to setting federal R&D priorities was recommended in *Science for Society, Cutting-Edge Basic Research in the Service of Public Objectives,* May 2001, sponsored by the Packard and Sloan Foundations. It recommended that federal R&D support should include "basic science that is targeted in an area of important societal objectives, or 'Jeffersonian Science.'" This applications-oriented science would "speed societal progress"and enhance public support for science because it would more clearly link basic research and public objectives (pp. 69-70).

NSF Funding. NSF funds research across all disciplines and is the main federal source for much nonhealth-related academic research. The Coalition for National Science Funding (CNSF), which represents many universities and professional science associations, in a February 7, 2002 press release, recommended a 15% increase for NSF and doubling of its budget by FY2006. The Federation of American Societies for Experimental Biology endorsed doubling of the NSF budget as critical to biomedical research advances.[14] P.L. 107-368, the NSF authorization bill for FY2003, authorized increases in NSF's budget by 15% for each of FY2003, FY2004, and FY2005, which according to the sponsors, would "put the NSF on the track to double its budget within five years," (FY2008) similar to the NIH doubling track in an effort to increase federal support for science fields which, in recent years, have not experienced the larger percentage increases which have gone to biomedical R&D. The law also required increased oversight of NSF facilities programs. Congress appropriated about $4.1 billion for NSF's FY2004 R&D funding, a 4.7% increase over FY2003, and about $1.0 billion less than envisioned in the authorization act. P.L. 107-368 required the National Science Board, which governs NSF together with the Director, to report on how NSF's increased funding should be used. In a 2003 report, *Fulfilling the Promise: A Report to Congress on the Budgetary and Programmatic Expansion of the National Science Foundation,* the Board recommended annual NSF funding of $19.0 billion, and outlined priorities for support. As noted, FY2005 congressional appropriations action reduced NSF's budget for R&D by about 0.3% from FY2004.

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[13] John T. Softcheck, "New Advocacy Organization Will Promote Funding for Research in the Non-biological Sciences," *Washington Fax,* Feb. 26, 2001. See also David Malakoff, "Perfecting the Art of the Science Deal," *Science,* May 4, 2001, pp. 830-835.

[14] See *Federal Funding for Biomedical and Related Life Sciences Research FY2002.*

Federal R&D Priority-Setting Structures

Some observers recommend more centralized priority-setting for R&D in Congress and in the executive branch. Some cite a need for an executive branch mechanism to determine a unified R&D budget and to evaluate the total government R&D portfolio in terms of progress toward meeting national objectives. Others say that congressional jurisdiction for R&D is split among a number of committees and subcommittees, preventing examination of the R&D budget as a whole. This means that R&D funding can serve particular local or program interests, but may not be appropriate for a national R&D agenda. Opponents see value in a decentralized system in which budgets are developed, authorized, and appropriated separately by those most familiar with the needs of specific fields of R&D — the department or agency head and the authorizing and appropriations subcommittees with jurisdiction.

Unified Federal Science and Technology (FS&T) Budget

In a 1995 report, *Allocating Federal Funds for Science and Technology,* the National Academies recommended that the President use, and that the Congress consider, the R&D budget as a unified whole before its separate parts for each agency are considered by individual congressional committees. It recommended that R&D requested in the budget be reconfigured as a S&T budget, excluding defense development, testing and evaluation activities, to denote basic and applied R&D and the creation of new knowledge. Since the FY2002 budget request, OMB has used a modified version of the format proposed by the Academy, and identified a "Federal Science and Technology (FS&T) budget table," which, for FY2005, includes less than half of total federal R&D spending and some non-R&D funding, such as education and dissemination of information.[15] FS&T funding would decrease about 0.4% from FY2004 to FY2005. It is possible that the OMB will continue to use this alternative format, paving the way for congressional consideration of a realigned and unified S&T budget. S.Amdt. 2235 to the Senate budget resolution (S.Con.Res. 86) for FY1999 expressed the sense of the Senate that for FY2000-2004, all federal civilian S&T spending should be classified under budget function 250. This has not occurred. Senator Jeff Bingaman, in a February 2004 speech called for consideration of a unified federal S&T budget: "It would be valuable to have joint hearings across the relevant committees in the Senate on the overall shape of our S&T spending. It might be worth considering whether the functional nature of the budget itself should be revised to put the entire federal S&T budget in one place, so that there is much more transparency as to what the real trends are...."[16]

Interagency R&D Initiatives

Executive Order 12881, issued by President Clinton, established the National Science and Technology Council (NSTC) with cabinet-level status. Located in the Executive Office of the President, it recommends agency R&D budgets to help accomplish national objectives, advises OMB on agency R&D budgets, and coordinates presidential interagency R&D initiatives. Beginning with the FY1996 budget request, NSTC identified interagency R&D

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[15] Sec. 6, *FY2005 Budget, Analytical Perspectives.*

[16] "Bingaman: A Revitalized Science and Technology Policy Badly Needed," op. cit.

budget priorities. The FY2005 budget identified agency funding for two interagency R&D initiatives whose reporting is required by statute, "Networking and Information Technology R&D," at $2,008 million, a 1% decrease from FY2004, and "Climate Change Science Program," which incorporated the U.S. Global Change Research Program, at $1,958 million, a 2% decrease from FY2004. A priority interagency Administration initiative is for nanotechnology, funded at $886 million, a 3.0% increase over FY2004. Other FY2005 interagency R&D initiatives are in combating terrorism and hydrogen. FY2006 initiatives include those for FY2005 and R&D in physical sciences, biology of complex systems, and water. Combating terrorism is now called homeland security R&D.[17]

Proposals to Coordinate Federal R&D

The National Science Board (NSB) report, *Federal Research Resources: A Process for Setting Priorities*, October 11, 2001, (NSB 01-160) recommended a *"continuing advisory mechanism"* in Congress and the executive branch and a strengthened OMB/OSTP relationship to coordinate R&D priorities. It said that federal R&D funding should be looked at as a five-year planned portfolio, rather than as the sum of the requirements and programs of departments. AAAS President Mary Good, recommended creating a *cabinet-level post for S&T* to help achieve balance in R&D and coordinate federal R&D and handle research policy issues.[18] The Commission on National Security recommended empowering the President's science advisor to establish *"functional budgeting,"* to identify nondefense R&D objectives that meet national needs, strengthen the OSTP, NSTC and PCAST, and improve coordination with OMB to enhance stewardship of national R&D. The congressional science policy report, *Unlocking Our Future*, 1998, spearheaded by Representative Vernon Ehlers, called for more balance in the federal research portfolio and said that while OMB can fulfill the coordination function in the executive branch, "no such mechanism exists in the Congress. ...[I]n large, complex technical program, ... committees should ... consider holding joint hearings and perhaps even writing joint authorization bills" (p. 7).

Legislation on Technology Assessment

The aforementioned NSB report also recommended that Congress develop "an appropriate mechanism to provide it with independent expert S&T review, evaluation, and advice" (p. 16). Some believe that this could pertain to reestablishing the Office of Technology Assessment (OTA), which was active between 1972 and 1995 as a congressional support agency. It prepared in-depth reports and policy options about the consequences of S&T and was eliminated as part of the reductions Congress made in a FY1996 appropriations bill. In June 2001, a conference was held to assess ways to "resurrect" OTA or variants of it. Advocates cited the need for better congressional support for S&T analysis.[19] The OTA

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[17] OMB, "Updated Administration Research and Development Budget Priorities," Memorandum 04-23, Aug. 12, 2004.

[18] Rebecca Spieler, "AAAS President Concerned About Imbalances in Nation's R&D Portfolio...," *Washington Fax*, Feb. 21, 2001.

[19] Wil Lepkowski, "The Mummy Blinks," *Science and Policy Perspectives*, June 25, 2001; D. Malakoff, "Memo to Congress: Get Better Advice," *Science*, June 22, 2001: 2229-2230; and M. Davis, "A Reinvented Office of Technology Assessment May Not Suit Congressional Information (continued...)

is still authorized, but funds would have to be appropriated for it. The pros and cons of reviving OTA or re-creating a similar body have been examined since its termination. During the 107th Congress, H.R. 2148, a bipartisan bill, would have authorized OTA funding at $20.0 million annually for five years. Since 2002, at congressional direction, the General Accountability Office (GAO; formerly the General Accounting Office) has conducted two pilot technology assessments, *Technology Assessment: Using Biometrics for Border Security*, GAO-03-174, 2002, and *Cybersecurity for Critical Infrastructure Protection*, GAO-04-321, and has begun two others, on port security and on protecting buildings from forest fire. Current legislative action includes proposals to restore OTA's funding (H.R. 125); to create a Science and Technology Assessment Service to conduct assessments for Congress (H.R. 6 as passed in the Senate); to conduct technology assessments in GAO (report language on H.R. 2657 and on H.R. 4755); and to create a technology assessment capability in GAO (S. 2556) or under its direction (H.R. 4670, which would create a Center for Scientific and Technical Assessment).

In FY2005 Legislative Branch Appropriations action, Representative Holt offered H.Amdt. 667 to H.R. 4755, to add $30 million to GAO's account for a Center for S&T Assessment; the House rejected the amendment on July 12, 2004. The House Legislative Branch Appropriations report (H.Rept. 108-577) encouraged GAO to retain its core capability to conduct technology assessments. S.Rept. 108-307, to accompany S. 2666, indicated that while the Senate Appropriations Committee supported GAO doing technology assessments, it did not intend to appropriate specific funding for this purpose and that GAO should conduct assessments that are supported by both House and Senate leadership and that address issues of national scope. The report instructed GAO to consult with the committee regarding definitions and procedures to conduct technology assessment. Issues under debate have included the need for assessments, funding, utility of GAO's reports, and options for institutional arrangements. See also *Technology Assessment in Congress: History and Legislative Options*, CRS Report RS21586.

Earmarking

There is controversy about congressional designation of R&D funding for specific projects, also called earmarking. When using this practice, Congress, in report language or law, directs that appropriated funds go to a specific performer or designates awards for certain types of performers or geographic locations. Typically an agency has not included these awards in its budget request and often such awards may be made without prior competitive peer review. Critics say that earmarking undermines the authorization process and distorts agency R&D priorities. Supporters believe the practice helps to develop R&D capability in a wide variety of institutions, that it compensates for reduced federal programs for instrumentation and facilities renewal, and that it generates economic benefits in targeted regions since R&D capacity may generate industrial growth. Section 6 of *Analytical Perspectives, FY2005 Budget*, using data from *Chronicle of Higher Education*, reported that academic R&D funded at congressional direction for FY2003 totaled $2.012 billion, up 9.5% over FY2002. According to AAAS, FY2005 R&D earmarks totaled $2.1 billion, mostly for

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[19] (...continued)
Requirement...," *Washington Fax*, June 18, 2001. See also M. Granger Morgan and John M. Peha, *Science and Technology Advice for Congress*, Washington, Resources for the Future, 2003, 208-227.

projects in DOD, DOE, USDA, and NASA in that order.[20] The Administration seeks to discourage earmarking saying that it distorts agency priorities. A conference on the pros and cons of earmarking was held on October 3, 2001.[21]

Government Performance and Results Act (GPRA) and PART

The Government Performance and Results Act of 1993 (GPRA), P.L. 103-62, is intended to produce greater efficiency, effectiveness, and accountability in federal spending and to ensure that an agency's programs and priorities meet its goals. It also requires agencies to use performance measures for management and, ultimately, for budgeting. Recent actions have required agencies to identify more precisely R&D goals and measures of R&D outcomes. As underscored in *The President's Management Agenda,* beginning in FY2001 and in each year thereafter, the Bush Administration has emphasized the importance of performance measurement, including for R&D. Section 6 of OMB's *Analytical Perspectives, Budget of the U.S. Government, FY2005,* discusses requirements for agencies to use specific OMB-defined criteria to measure the outcomes of basic and applied research, focusing on measures of relevance, quality, and performance. R&D projects relevant to industry are to meet additional criteria relating to the appropriateness of public investment, demonstrate a capability to measure benefits, and identify decision points to transition the activity to the private sector. The Administration is also assessing some R&D programs by use of a new Program Assessment Rating Tool (PART) which uses the R&D criteria and other measures. PART results for 58 R&D programs were used when making FY2005 budget decisions. Commentators have pointed out that it is particularly difficult to define priorities for most research and to measure the results quantitatively, since research outcomes cannot be defined well in advance and often take a long time to demonstrate, and that, as a result, there is little confidence that R&D performance measures can be used to recommend budget levels for most R&D.

The National Academies [of Science] (NAS) issued two reports to assist agencies in developing performance measures for research. The most recent is entitled *Implementing the Government Performance and Results Act for Research: A Status Report, 2001*. As for Congressional interest, the House Science Committee's science policy report, *Unlocking Our Future*, 1998, commonly called the Ehlers report, recommended that a "portfolio" approach be used when applying GPRA to basic research. P.L. 106-531 mandated that an agency head assess the completeness and reliability of performance data used in reports to Congress and the House adopted a rule with the passage of H.Res. 5 (106th Congress) requiring all "committee reports [to] include a statement of general performance goals and objectives, including outcome-related goals and objectives for which the measure authorizes funding." (See CRS Report RS20257, *Government Performance and Results Act: Brief History and Implementation Activities* and CRS Report RL32164, *Performance Management and Budgeting in the Federal Government: Brief History and Recent Developments*.)

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[20] AAAS, "R&D Funding Update," Nov. 29, 2004 [http://www.aaas.org/spp/rd/upd1104.htm].

[21] See David Malakoff, "White House Asks Community to Oppose Earmark Projects," *Science*, Sept. 28, 2001, p. 2364.

Table 3. R&D in the Budget, by Agency, Based Largely on AAAS Data

(Budget authority in millions of dollars

SELECTED AGENCIES & PROGRAMS	FY2000 actual	FY2001 actual	FY2002 actual	FY2003 actual	FY2004 estimate	FY2005 request	House Comm. (c) Flr. (f)	Senate Comm. (c) Flr. (f)	Final Ap-proved	%Change, Projected FY2004, est. to FY2009, requested	
										Current $	Constant $
Dept. of Agr. Total	$1776	$2181	$2112	$2334	$2240	$2163	$2375 (c)	$2367(c)	$2414	-3.6%	-11.3%
(Agr. Res. Service)	—	*(1012)*	*(1234)*	*(1294)*	*(1171)*	*(1191)*	*(1284) (c)*	*(1288) (c)*	*(1313)*	—	—
(CSREES)	—	*(594)*	*(532)*	*(608)*	*(619)*	*(512)*	*(625)* (c)	*(620) (c)*	*(643)*	—	—
(Forest Service)	—	*(245)*	*(265)*	*(265)*	*(316)*	*(316)*	*(328) (c)*	*(325(c)*	*(322)*	—	—
Dept. of Commerce Total	1174	1030	1328	1200	1131	1075	946 (f)	1334 (c)	1183	-6.1%	-13.6%
(NOAA)	*(643)*	*(561)*	*(611)*	*(666)*	*(617)*	*(610)*	*(545) (f)*	*(748) (c)*	*(684)*	*-2.8%*	*-10.5%*
(NIST)	*(471)*	*(413)*	*(460)*	*(491)*	*(471)*	*(426)*	*(369) (f)*	*(540) (c)*	*(468)*	*-10.1%*	*-17.3%*
(ATP) (Within NIST)	*(116)*	*(118)*	*(150)*	*(153)*	*(152)*	*0*	*0*	*(164) (c)*	*(110)*	—	—
Dept. of Defense Total	39959	42740	49877	59296	65656	68759	69156	69544	70285	8.6%	0.0%
(S&T (6.1-6.3+ medical))	*(8632)*	*(9365)*	*(10337)*	*(11186)*	*(12558)*	*(10623)*	*(13011)*	*(12480)*	*(13550)*	*-10.8%*	*-17.9%*
Dept. of Education	238	264	265	282	290	304	259 (c)	(260) (c)	258	3.1%	-5.1%
Dept. of Energy Total	6956	7733	8078	8312	8804	8880	8945 (c)	(8880) (c)	8956	7.5%	-1.1%
(Atomic/Defense)/(NNSA+Defense)	*(3201)*	*(3462)*	*(3855)*	*(4049)*	*(4244)*	*(4333)*	*(4358) (c)*	*(4333) (c)*	*(4293)*	*14.7%*	*5.6%*
(Energy & Science)	*(3755)*	*(4271)*	*(4224)*	*(4263*	*(4560)*	*(4547)*	*(4587) (c)*	*(4547) (c)*	*(4663)*	—	—
Dept. of HHS Total	18182	21045	23696	27411	28469	29361	29299 (c)	29720(c)	29108	3.0%	-5.2%
(NIH)	*(17234)*	*(19807)*	*(22714)*	*(26398)*	*(27220)*	*(27923)*	*(27923) (c)*	*27,923(c)*	*(27771)*	*2.3%*	*-5.8%*
Dept. of Homeland Security*	—	—	266	737	1037	1141	1238 (c)	1216(c)	1243	35.8%	25.0%
Dept. of Interior Total	618	621	641	643	675	648	672f	670 (c)	672	-5.4%	-12.9%
(U.S. Geological Survey)	—	*(566)*	*(583)*	*(550)*	*(547)*	*(525)*	*(548)f*	*(548) (c)*	(545)	—	—
Dept. of Transportation Total	607	718	778	700	707	755	669(c)	719 (c)	718	6.4%	-2.1%
(FAA)	*(220)*	*(301)*	*(359)*	*(271)*	*(250)*	*(222)*	*(226) (c)*	*(269) (c)*	*(262)*	—	—
(FHA)	*(261)*	*(294)*	*(275)*	*(291)*	*(246)*	*(394)*	*(319) (c)*	*(315) (c)*	*(319)*	—	—
(NHTSA)	*(51)*	*(58)*	*(59)*	*(61)*	*(58)*	*(68)*	*(60) (c)*	*(61) (c)*	*(62)*	—	—

SELECTED AGENCIES & PROGRAMS	FY2000 actual	FY2001 actual	FY2002 actual	FY2003 actual	FY2004 estimate	FY2005 request	House Comm. (c) Flr. (f)	Senate Comm. (c) Flr. (f)	Final Ap-proved	%Change, Projected FY2004, est. to FY2009, requested	
										Current $	Constant $
Dept. of Veterans Affairs	645	719	756	819	820	770	770 (c)	820 (c)	813	-7.8%	-15.1%
Environmental Protection Agency	558	574	592	567	616	572	589 (c)	604 (c)	598	-7.6%	-15.0%
NASA Total	9494	9887	10224	10681	10909	11334	10235 (c)	10465(c)	11132	32.4%	21.9%
(Space Flight)	*(3014)*	*(2901)*	*(2461)*	*(3613)*	*(3136)*	*(4135)*	*(2686) (c)*	*(3100)(c)*	*(4038)*	—	—
(Science, Aeronautics, Tech.)	*(6481)*	*(7024)*	*(7840)*	*(7386)*	*(7883)*	*(7199)*	*(7549) (c)*	*(7866) (c)*	*(7094)*	—	—
National Science Foundation	2931	3320	3525	3926	4077	4226	4038(c)	4195(c)	4063	3.5%	-4.7%
All other R&D	630	702	912	391	745	730	745 (c)	934 (c)	756	-3.2%	-10.9%
TOTAL	83769	91534	102899	117439	126176	130717	131206(c)	132885(c)	132200	8.7%	0.0%
NonDefense	40609	45332	49167	54552	55989	57218	56101	*57816*	*57224*	*8.1%*	*-0.5%*
NonDefense Minus NIH	*23374*	*25525*	*26453*	*28243*	*28770*	29295	28178	29530	*29453*	—	—
Defense	43160	46202	53731	62887	70187	73499	75105	*75070*	*74976*	*9.2%*	*0.5%*

Source: Based largely on American Association for the Advancement of Science, with tables appearing at [http://www.aaas.org/spp/rd/] AAAS,"Research Holds, Development Gains in 2005 Budget, AAAS Preliminary Analysis of R&D in the FY2005 Budget," Feb. 5, 2004, and "FY2004 Federal R&D Climbs to Record High of $127 Billion; Defense and Homeland Security Up, Other Programs Share in Modest Gains," and other updates, including "AAAS R&D Funding Update," Nov. 29, 2004. AAAS bases its tables on OMB data, agency budget justifications, information from agency budget offices, and appropriations action. Data in italics in parentheses are parts of the total and have been included in agency totals. Projected data in the last 2 columns are from AAAS, "Bush Proposes to cut Nondefense R&D Over the Next Five Years to Reduce Deficit," Apr. 22, 2004, revised May 7, 2004. The data in the last two columns are AAAS analyses of defense and nondefense R&D, based on detailed budget account projections accompanying the *Budget of the United States Government, FY2005.* See also CRS Issue Brief IB10129: *Federal Research and Development Funding*.

*FY2002 data for comparison purposes only. DHS was to begin operations in FY2003. DHS figures include programs to be transferred from other agencies.
The FY2004 and FY2005 figures were revised downward by AAAS to reflect that TSA R&D figures were revised since the Feb. release of the budget.
The final FY2005 figures include adjustments to reflect across-the-board reductions in the FY2005 omnibus bill.