Observations on the President's Fiscal Year 1999 Federal Science and Technology Budget

Committee on Science, Engineering, and Public Policy

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Preface

In 1995, a National Academy of Sciences (NAS)-National Academy of Engineering (NAE)-Institute of Medicine (IOM)-National Research Council (NRC) committee issued a report titled *Allocating Federal Funds for Science and Technology*.

The committee recommended development of a federal science and technology (FS&T) budget that would reflect the real federal investment in the creation of new knowledge and technologies and exclude activities not involving the creation of new knowledge or technologies, such as the testing and evaluating of new weapons systems. An NAS panel later issued a series of reports with quantitative and qualitative assessments of the FS&T budget.

Beginning this year, the Committee on Science, Engineering, and Public Policy (COSEPUP), a joint committee of the NAS, NAE, and IOM, will issue these annual assessments (which are available on COSEPUP's web site: http://www2.nas.edu/cosepup). To eliminate duplicate quantitative analysis of the budget by COSEPUP, the American Association for the Advancement of Science (AAAS), in cooperation with the Academies, has now added a quantitative assessment of the FS&T budget to its annual assessment. The results of their analysis of the FS&T budget are presented in Appendix B and can also be seen at http://www.aaas.org.

COSEPUP is now publishing its assessment of the FS&T budget in AAAS's annual R&D report. The assessment is chapter 6 of AAAS's Intersociety Working Group report, *AAAS Report XXIII: Research and Development FY 1999*. This provides a "one-stop" assessment of the research budget and should be useful for members of Congress, the administration, federal agencies that support research, disciplinary societies, researchers, and all others involved and interested in the investment in research made by this nation.

The committee acknowledges the invaluable information and opinions received from the participants in its planning meeting for this activity held in December 1997.

The production of the report was the result of hard work by the committee as a whole and by the extra efforts of the Guidance Group chaired by Jim Duderstadt.

The project was aided by the invaluable help of COSEPUP professional staff—Deborah D. Stine, study director, and Patrick P. Sevcik, research associate; its consultant, Michael McGeary; and editor Norman Grosblatt. A special thank you goes also to the AAAS staff of Al Teich and Kei Koizumi for their advice and analysis.

Phillip A. Griffiths, *Chair*
Committee on Science, Engineering,
and Public Policy

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HIGHLIGHTS

In this report, the Committee on Science, Engineering, and Public Policy (COSEPUP) provides its observations on the federal science and technology (FS&T) portion of the president's fiscal year (FY) 1999 submission. The FS&T budget (see box) reflects the federal investment in the creation of new knowledge and technologies and excludes such activities as the testing and evaluating of new weapons systems.

Provided below are the highlights of this report

- The president's FY 1999 budget proposes an increase[1] in the FS&T budget (a 1.3% increase over the FY 1998 budget in constant dollars). This proposed increase would bring FS&T to within 1.8% of its FY 1994 level in constant dollars.
- The National Institutes of Health (NIH) and the National Science Foundation (NSF) have received increased investment since 1994. NIH's FY 1999 FS&T budget would be 21.3% larger than its FY 1994 budget in real terms. NSF's would be 14.3% larger.
- The FS&T budgets of other agencies that support research and graduate education and have important influences on the development of specific fields (such as physical sciences, engineering, computer science, and mathematics) have declined since FY 1994. Funding for FS&T in these agencies as a group would be down by 11.0% from FY 1994.
- The cross-cutting initiatives in the president's budget target national goals requiring broad investment by a number of research agencies. Issues addressed in FY 1999 include climate-change technology, large-scale networking and high-end computing and computation, education, and emerging infectious diseases. Cross-cutting initiatives can be important in making the nation's federal research investment more efficient and effective.

[1]COSEPUP recognizes that the increases in the FS&T budget are based on an uncertain funding source—the tobacco settlement—and that there are issues regarding the caps on discretionary spending.

What is the FS&T Budget?

In 1995, the National Academy of Sciences (NAS)-National Academy of Engineering (NAE)-Institute of Medicine (IOM)-National Research Council issued a report titled *Allocating Federal Funds for Science and Technology*. For the United States to maintain its leadership in science and technology, this report recommended increased coherence in federal science and technology (FS&T) budgeting. Given the always limited budgets for research, Congress and the administration could free funds for important new opportunities by reducing support for less-important activities (see http://www2.nas.edu/cosepup).

The report recommended development of an FS&T budget that would reflect the real federal investment in the creation of new knowledge and technologies and exclude activities not involving the creation of new knowledge or technologies, such as the testing and evaluating of new weapons systems. It would amount in FY 1999 to about $47.1 billion, compared with the $77.7 billion currently reported as federal research and development.

The FS&T budget includes the funding for basic and applied research of all departments and agencies (including “6.1” and “6.2” at the Department of Defense) and all civilian development funding, but only the part of defense development at the Department of Defense (DOD) and the Department of Energy (DOE) that includes generic technology development (“6.3” at DOD and its equivalent in the DOE atomic energy defense program).

- The president proposes a Research Fund for America (RFFA) that highlights $31 billion of the nondefense budget as a priority. As noted by Franklin Raines, director of the Office of Management and Budget (OMB), the RFFA is closely patterned on the Academies’ *Allocating Federal Funds* report, which called for an integrated FS&T budget. Unlike FS&T, the RFFA does not include defense-related research.

THE PRESIDENT PROPOSES AN INCREASE IN THE FS&T BUDGET FOR FY 1999

The president’s budget for FY 1999 includes $47.1 billion for FS&T, an increase of 1.3% over FY 1998 in constant dollars[2]; this represents an increase in the nation’s investment in the creation of new knowledge and technologies.

[2]The GDP deflator, which was about 2.2% per year in the 1994-1999 period (and is expected to continue through 2003), is used by both COSEPUP and AAAS in calculating constant-dollar figures.

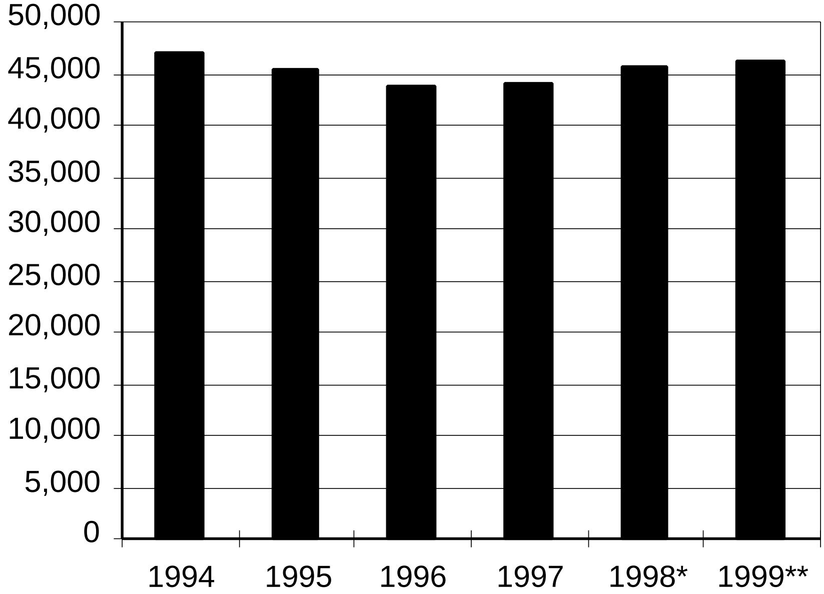


FIGURE 1 Trends in FS&T, FY 1994–1999 budget authority for total FS&T (conduct and facilities), millions of constant FY 1998 dollars. *Appropriated, **Requested.

The proposed increase for FY 1999 would bring FS&T to within 1.8% of its FY 1994 level in constant dollars (see figure 1; more in-depth information is provided in table A-1). This proposal constitutes a change in administration policy from a year ago, when the president's FY 1998 submission projected flat budgets for FS&T through FY 2002.

FUTURE PROJECTIONS OF THE FS&T BUDGET SHOW FUNDING FOR NIH AND NSF INCREASING DRAMATICALLY ABOVE FY 1994 LEVELS, WITH THE BUDGET FOR THE OTHER MAJOR RESEARCH AGENCIES REDUCED

Figure 2 shows the current and projected change in the FS&T funding for four key research agencies: NSF, NIH, DOE, and DOD. The percentage change for various periods is shown in table 1 (for more in-depth information, see table A-2). From the base year of FY 1994 to the projection for FY 2003, NIH funding would increase by 52% and NSF funding by 19% (in constant dollars). The FS&T budget for the other major research agencies, however, will have declined from FY 1994; DOE funding will have decreased by 11% and DOD by 26% over this period.

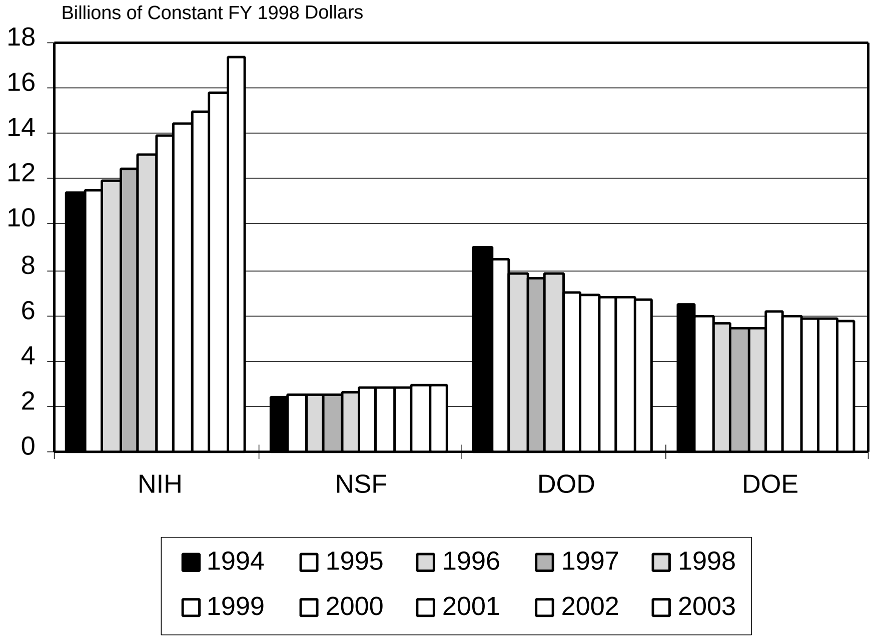


FIGURE 2 FS&T budget, by agency, FY 1994–FY 2003. Note: Budget authority for FY 1994-1997 is actual, for 1998 estimated, for 1999 requested, and for 2000-2003 as projected by OMB. Constant dollars were calculated with the GDP deflator.

IT IS IMPORTANT TO ANALYZE THE EFFECTS OF PAST AND EXPECTED FUNDING SHIFTS ON SPECIFIC SCIENCE AND TECHNOLOGY FIELDS

NIH's FS&T budget would be 21.3% larger in FY 1999 (by $2.4 billion in FY 1998 dollars) than in FY 1994 in real terms. NSF's would be 14.3% larger (by $0.4 billion in FY 1998 dollars). The FS&T budget for the four other major research agencies as a group would be 11.0% smaller in FY 1999 (by $3.7 FY 1998 dollars) than in 1994. As shown in Appendix B, most of the mission research agencies—such as DOD, DOE, the US Department of Agriculture (USDA), and the National Aeronautics and Space Administration (NASA)—would continue to have smaller FS&T budgets than they had in FY 1994.

How does such a shift in federal funding patterns affect specific scientific and engineering fields? The agencies with reduced FS&T budgets are the major supporters of research and graduate education in some fields, and they provide a critical component of support for the national science and engineering enterprise. For example, agencies other than NIH and NSF provide 92% of federal funding

TABLE 1 Percentage Changes in FS&T Budget, FY 1994-FY 2003 (constant dollars)

	FY 1998-1999	FY 1994-1999	FY 1994-2003
Agency	Change, %	Change, %	Change, %
NIH	+6.0	+21.3	+51.9
NSF	+9.1	+14.3	+18.5
DOD	–9.7	–22.2	–25.7
DOE	+13.5	–4.7	–10.8

of research in physics, 85% in computer science, and 90% in engineering. That research is performed by intramural federal laboratories and extramural industrial laboratories, universities and colleges, federally funded R&D centers, and other nonprofit and government entities. For universities and colleges, agencies other than NIH and NSF support substantial percentages of the research performed in those fields: 69% in physics, 69% in computer science, and 57% in engineering.[3]

Table 2 provides the only recent funding data available by broad field. The data, collected by NSF, provide information on actual and estimated obligations from FY 1993 to FY 1997. Total federal spending on basic and applied research[4] in constant dollars declined by 1.2% from FY 1993 (its high point) to FY 1997 (see table 2). Although spending by NIH and NSF was up by 6.8%, this increase was more than offset by reductions in the FS&T budgets of other agencies.

The increased NSF support for academic engineering research compensated for cuts in DOD support; how this has affected the engineering fields supported primarily by DOD is worth investigating. Cuts in the other fields of concern have not necessarily been offset by proportional increases elsewhere. For example, increases in support by NIH and NSF for academic research in the environmental and social/behavioral sciences have not compensated for decreased support from the other agencies; they are down 5.1% and 7.3% respectively.

DOD, NASA, DOE, and other mission agencies provide a substantial proportion of federal funding for graduate students in the fields where they are the major federal funders—47% in physical sciences, 58% in mathematics, 64% in computer science, and 67 % in engineering. Funding changes that affect those agencies might also affect the amount of graduate-student support that is available for students in those fields. For example, the number of science and engineering graduate students for whom DOD is the primary source of funding de-

[3]Calculated from tables C23-C26 (all performers) and C68-C-71 (universities and colleges) in NSF, *Federal Funds for Research and Development, Fiscal Years 1995, 1996, and 1997, Vol. 45, Detailed Statistical Tables*. NSF 97-327. Arlington, VA: National Science Foundation, 1997.

[4]This part of the analysis focuses on obligations for research as opposed to R&D, because NSF does not collect statistics on development funding by field.

TABLE 2 Real Percentage Changes in Federal Obligations by Field, FY 1993–FY 1997 (constant dollars)

	Change, %					
	Total Research			Academic Research		
Field	NIH+NSF	All Others	Total	NIH+NSF	All Others	Total
All fields	+6.8	–6.4	–1.2	+5.0	–13.1	–0.2
Life sciences	+6.4	–2.2	+4.0	+2.6	–10.8	+1.0
Physical sciences	–0.7	–11.0	–9.6	–4.2	–9.5	–7.3
Environmental sciences	+8.9	+2.1	+3.1	+4.0	–13.5	–5.1
Mathematics and Computer science	+4.1	+17.7	+14.8	–3.3	+1.8	–0.4
Engineering	+62.4	–10.0	–5.5	+77.3	–15.9	+11.0
Social and Behavioral	+13.1	–5.8	+2.4	+3.4	–37.5	–7.3

Note: Obligations are the amounts for grants and contracts awarded, orders placed, services received, and similar commitments during a given period, regardless of when the funds were appropriated or of whether future payments are required.

Source: Calculated from NSF 97-327 (FY 1995-FY 1997), 96-319 (total research, FY 1993-FY 1994), and NSF 96-318 (academic research, FY 1993-FY 1994).

creased from 9,315 in 1993 to 8,470 in 1996[5]. An in-depth study is warranted to learn the effect of the above funding changes for key science and engineering fields, including the effect on the number and quality of the graduate students in each field.

SUCCESSFUL RESULTS FROM THE INCREASED FUNDING FOR NIH ALSO DEPEND ON THE HEALTH OF THE PHYSICAL AND MATHEMATICAL SCIENCES

As indicated in the NAS *Beyond Discovery* series[6], which uses well-known applications of science and technology to illustrate how research has led to breakthroughs that have greatly benefited society, every breakthrough stems from research conducted in many science and engineering fields. Although the expanded investment in health research focuses on NIH, research results in other science and engineering fields are also critical for improving health. As indicated by Harold Varmus, director of NIH[7]:

[5]NSF and SRS, unpublished tables from survey of graduate students and postdoctorates in science and engineering, fall 1996.

[6]NAS, *Beyond Discovery: The Path from Research to Human Benefit.* Washington, DC: National Academy Press, http://www2.nas.edu/bsi.

[7]Varmus, H. “New Directions in Biology and Medicine,” AAAS plenary lecture, Philadelphia, February 13, 1998.

How to Get the Best "Bang" for the Federal Research Dollar

The highest-quality projects and people should be supported with FS&T funds. As indicated in the *Allocating Federal Funds* report, the best way to ascertain that the highest-quality projects and people are supported is some form of competition involving rigorous evaluation of merit.

Competitive merit review involves use of criteria that include technical quality, the qualifications of the proposers, relevance and educational impacts of the proposed project, and other factors pertaining to research goals, such as the mission of the funding agency. Competition means that, at some level within the framework of an agency's mission, researchers who propose the best ideas are selected. In an open competition, anyone may apply and be funded, regardless of institution or geographic location. In the case of highly targeted missions, quality can also be maintained by knowledgeable program managers who use external scientific and technical advisory groups to help assess quality and to help monitor whether agency needs are being met.

Judgment in the application of merit review is warranted because it is not a perfect system. What is defined as merit and who determines merit are key ingredients.

> Most of the revolutionary changes that have occurred in biology and medicine are rooted in new methods. Those, in turn, are usually rooted in fundamental discoveries in many different fields. Some of these are so obvious that we lose sight of them—like the role of nuclear physics in producing the radioisotopes essential for most of modern medical science. Physics also supplied the ingredients fundamental to many common clinical practices—X rays, CAT scans, fiber optic viewing, laser surgery, ECHO cardiography and fetal sonograms. Materials science is helping with new joints, heart valves, and other tissue mimetics. Likewise, an understanding of nuclear magnetic resonance and positron emissions was required for the imaging experiments that allow us to follow the location and timing of brain activities that accompany thought, motion, sensation, speech, or drug use. Similarly, X-ray crystallography, chemistry, and computer modeling are now being used to improve the design of drugs, based on three-dimensional protein structures. . . . These are but few of many examples of the dependence of biomedical sciences on a wide range of disciplines—physics, chemistry, engineering and many allied fields.

Some observers have suggested that in this post-Cold War era we should shift away from partitioning R&D into civilian and noncivilian categories and instead use such categories as health versus nonhealth research. Because of the intimate synergistic relationships between the disciplines of science and the re-

Setting Goals for the Nation's Research Investment

In its 1993 report *Science, Technology and the Federal Government: National Goals for a New Era,* COSEPUP proposed two primary research goals for federal funding of research: the United States should perform at least at world-class levels in all major fields of science, and the United States should seek preeminence in a select number of fields (see http://www2.nas.edu/cosepup).

The goal that US scientists and engineers should work at the forefront of all major fields is necessary if the United States is to maintain its competitive position in the long term. We must be able to educate effectively the next generation of scientists and engineers and to assimilate and extend modern breakthroughs in different fields.

When should we single out particular fields of science for special support? Preeminence might be desired for a field that is tightly coupled to national objectives. Or a field might so powerfully affect other fields as to have a multiplicative effect on scientific advances. One field might hold overriding importance because it captures the public imagination.

Biomedical research is an example of a field in which preeminence is desired. Providing the best possible health care for our citizens and sustaining the strength of our biomedical industry are clearly national objectives.

To assess the status of various research fields, COSEPUP recommended "benchmarking" assessments by experts to determine the relative position of the United States in particular fields of science and engineering. COSEPUP has been conducting several tests of this concept. The first two, on mathematics and on materials science and engineering, have been released; a third, on immunology, will be released in the fall of 1998 (see http://www2.nas.edu/cosepup).

search activities of various federal agencies, however, such categories would obscure the interconnectedness of research and could fragment the scientific community.

CONCLUSION

In conclusion, an FS&T analysis of the president's FY 1999 R&D budget shows that it represents increased investment in the nation's science and engineering research compared with FY 1998.

Since FY 1994, NIH and NSF have received increased funding in real terms. This trend is projected by the administration to continue to FY 2003. The potential impact of decreased funding by DOE and DOD on support of research and graduate students in fields integral to national economic development needs to be examined. In addition, because NIH's efforts in health research also depend heavily on research that is supported by other agencies, the impact of funding changes needs to be examined here as well.

ADDENDUM

How Do the R&D, FS&T, and RFFA Budgets Differ?

As shown in figure 3, the R&D budget is $77.7 billion, the FS&T budget is $47.1 billion, and the RFFA is $31.1 billion. What are the differences between these three budgets?

The R&D budget incorporates all basic and applied R&D funded by the federal government. R&D funding normally includes personnel, program-supervision, and administrative-support costs directly associated with R&D activities; laboratory equipment is also included. Defense R&D includes testing, evaluation, prototype development, and other activities that precede actual production (known as RDT&E). Funding for R&D facilities includes construction, repair, or alteration of physical plant (reactors, wind tunnels, particle accelerators, or laboratories) used in the conduct of R&D. It also includes capital (major) equipment used in the conduct of R&D. Independent R&D (IR&D) is not included. (IR&D allows contractors to recover a portion of in-house R&D costs through overhead payments on federal procurement contracts.) More information is available in appendices 1&2.

The FS&T budget includes the civilian and noncivilian research budget for all agencies (including 6.1 and 6.2 at DOD) and the development budget for all agencies except DOD and DOE. For the development budget of the latter two agencies, only DOD 6.3 budget categories and the equivalent activities at DOE are included in the FS&T budget.

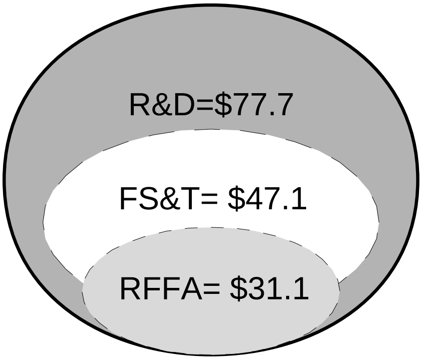


FIGURE 3 R&D vs. FS&T vs. RFFA budgets (in billions of dollars).

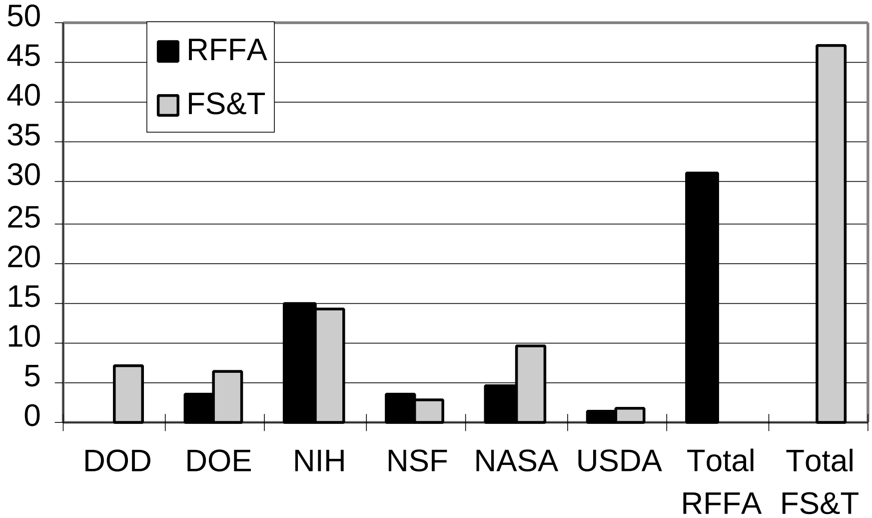


FIGURE 4 RFFA vs. FS&T, FY 1999 (billions of dollars).

The $31.1 billion RFFA budget emphasizes presidential priorities within the civilian portion of the R&D budget and another $3 billion of funds not classified as R&D. Of the $37 billion civilian R&D budget, it includes 95% ($15 billion) of funds for basic research, 77% ($9 billion) for applied research, and 49% ($4 billion) for development. The multiyear focus of the RFFA provides long-term emphasis on these priorities. It does not include the space station at NASA.

The president's budget submission does not explicitly define the characteristics of what is in the RFFA. The RFFA does not include the FS&T budgets of a number of small agencies that have research programs. It does include about $3 billion in programs, primarily at NSF and NIH, that are not classified as R&D according to OMB categories.

A comparison of the RFFA and the FS&T budget for the six largest research agencies is shown in figure 4 (in-depth information is provided in table A-3). Although it does not include defense-related research, the RFFA is an important step toward an integrated budget like the FS&T.

APPENDIX A

Data Tables

TABLE A-1 Trends in FS&T, FY 1994–FY 1999. Budget Authority for Total FS&T (Conduct and Facilities), in millions of constant FY 1998 dollars

	Federal S&T		Federal R&D	
Fiscal Year	Current $M	Constant $M	Current $M	Constant $M
1994	43,002	46,997	71,074	77,677
1995	42,688	45,485	70,948	75,597
1996	42,162	43,910	71,232	74,185
1997	43,340	44,161	73,934	75,335
1998	45,557	45,557	76,038	76,038
1999	47,057	46,134	77,735	76,211
Chg. FY 1998-FY1999	+3.3%	+1.3%	+2.2%	+0.2%
Chg. FY1994-FY1999	+9.4%	–1.8%	+9.4%	–1.9%

Sources: FS&T numbers from Table 1; R&D from AAAS Reports

TABLE A-2 FS&T Budget by Agency, FY 1994–FY 2003 (in millions of constant 1998 dollars)

	Act'l 1994	Act'l 1995	Act'l 1996	Act'l 1997	Est. 1998	Req. 1999	Prjctd 2000	Prjctd 2001	Prjctd 2002	Prjctd 2003
NIH	11,446	11,467	11,899	12,449	13,097	13,885	14,393	14,956	15,836	17,381
NSF	2,451	2,553	2,490	2,470	2,568	2,801	2,829	2,854	2,878	2,905
DOD	9,052	8,450	7,857	7,635	7,800	7,040	6,951	6,818	6,758	6,725
DOE	6,475	5,942	5,668	5,472	5,437	6,170	5,973	5,913	5,897	5,778

TABLE A-3 FS&T versus RFFA, FY 1999 (millions of dollars)

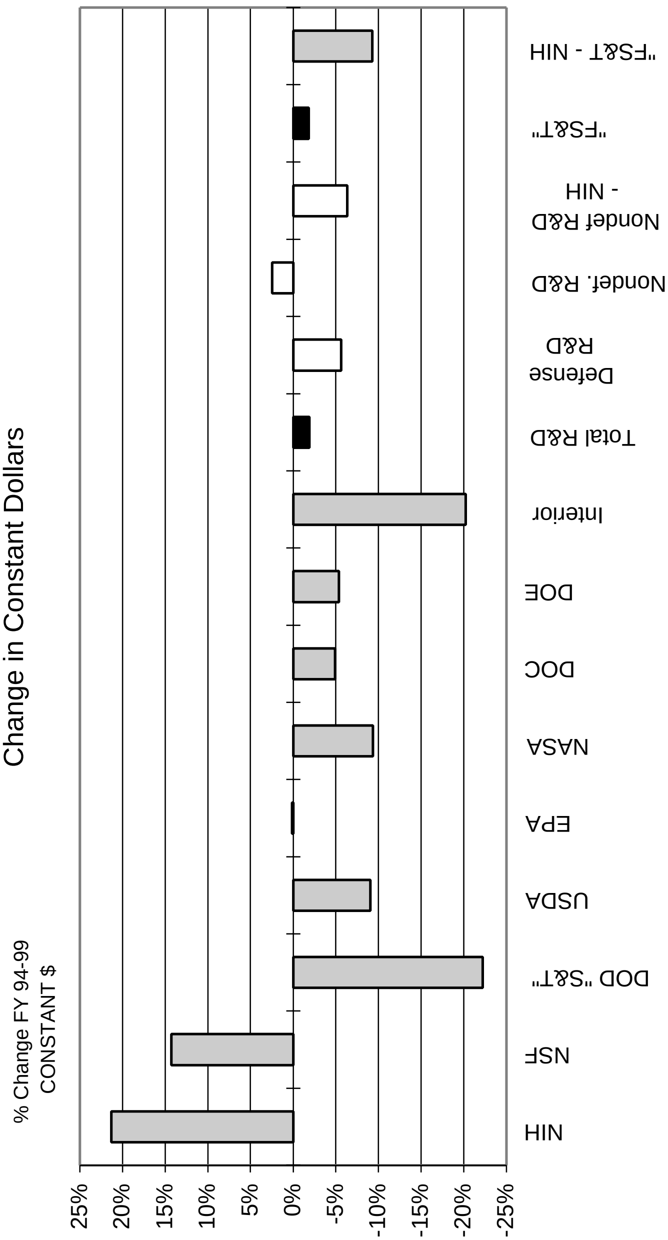
Agency	FS&T	RFFA*	Non-RFFA FS&T
Dept. of Defense	7,181	0	7,181
Dept. of Health & Human Services	14,888	14,869	19
• National Institutes of Health†	14,163	14,798	–635
National Aeronautics and Space Administration	9,504	4,605	4,899
Dept. of Energy	6,293	3,741	2,552
National Science Foundation	2,857	3,710	–853
United States Dept. of Agriculture	1,549	1,454	95
Dept. of Commerce	1,083	858	225
Dept. of the Interior	629	807	–178
Dept. of Transportation	775	0	775
Environmental Protection Agency	657	692	–35
All Others	1,641	360	1,281**
TOTAL FS&T	47,057	31,096	15,961

*Of the total, $3 billion of the RFFA is non-R&D/FS&T
**RFFA includes the Dept. of Veterans Affairs, Housing and Urban Development, Dept. of Education
†NIH is under the Department of Health and Human Services

APPENDIX B

Figures and Tables from AAAS Report XXIII: Research and Development FY 1999

Figure 3. Trends in R&D, FYs 1994-99
Change in Constant Dollars



Source: AAAS Report XX and OMB data for R&D in FY 1999 Budget. Adjusted for inflation according to OMB's GDP deflators.
DOD "S&T" - DOD R&D in "6.1" through "6.3" categories.

Table I-13. Trends in R&D, FY 1994-1999
Change in **Constant** Dollars

	FY 1994	FY 1998	FY 1999	**% Chg. in Constant $**	
	Actual	Estimate	Budget	**FY 94-98**	**FY 94-99**
Dept. of Defense	35,510	37,430	37,010	**-3.6%**	**-6.5%**
DOD 6.1-6.3	*8,283*	*7,800*	*7,181*	***-13.8%***	***-22.2%***
NASA	9,406	9,816	9,504	**-4.5%**	**-9.4%**
Dept. of Energy	6,771	6,288	7,142	**-15.0%**	**-5.4%**
Nat'l Institutes of Health	10,474	13,097	14,163	**14.4%**	**21.3%**
NSF	2,243	2,568	2,857	**4.8%**	**14.3%**
Agriculture	1,528	1,553	1,549	**-7.0%**	**-9.1%**
Interior	708	609	629	**-21.3%**	**-20.2%**
Transportation	641	676	775	**-3.5%**	**8.5%**
EPA	588	672	657	**4.6%**	**0.1%**
Commerce	1,022	1,081	1,083	**-3.2%**	**-4.9%**
All Other*	2,185	2,248	2,365	**-5.8%**	**-2.9%**
Total R&D	71,074	76,038	77,735	**-2.1%**	**-1.9%**
Defense R&D	38,299	40,409	40,289	**-3.5%**	**-5.6%**
Nondefense R&D	32,775	35,629	37,446	**-0.5%**	**2.5%**
Basic Research	13,693	15,710	16,917	**5.0%**	**10.8%**
"FS&T" [1]	43,002	45,557	47,057	**-3.1%**	**-1.8%**

Source: *AAAS Report XX*, OMB R&D data, and revised agency R&D estimates. Adjusted for inflation according to OMB's GDP deflators.

* - Includes non-NIH programs in Health and Human Services.

[1] An alternative measure for the federal investment in science and technology proposed by the National Academy of Sciences. This measure includes all federal R&D except for advanced development, testing and evaluation work in DOD and DOE. The DOD 6.1-6.3 categories represent the DOD contribution to the FS&T budget. DOE FS&T includes nearly all DOE R&D; the changes to DOE FS&T are -16.0% (FY 94-98) and -4.7% (FY 94-99)

Complete historical data (86-99) tables are available on the World Wide Web at: http://www.aaas.org/spp/dspp/rd/rdwwwpg.htm in the "Guide" section.

Table I-14. AAAS Analysis of the Projected Effects of the President's FY 1999 Budget on Federal R&D, FY 1998-2003

(budget authority in millions of dollars)

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	% Chg. FY '98-'03	
	Estimate	Budget	Projected	Projected	Projected	Projected	current $	**constant $**
Defense (military)	37,430	37,010	34,795	33,844	34,396	35,230	-5.9%	**-15.3%**
Health and Human Services	13,809	14,888	15,723	16,660	17,965	20,080	45.4%	**30.8%**
Nat'l Institutes of Health	*13,097*	*14,163*	*14,989*	*15,918*	*17,225*	*19,322*	*47.5%*	***32.7%***
NASA	9,816	9,504	9,397	9,389	9,493	9,513	-3.1%	**-12.8%**
Energy	6,288	7,142	7,061	7,117	7,219	7,236	15.1%	**3.5%**
Defense	*2,979*	*3,279*	*3,295*	*3,229*	*3,306*	*3,357*	*12.7%*	***1.4%***
Nondefense	*3,310*	*3,864*	*3,766*	*3,888*	*3,913*	*3,879*	*17.2%*	***5.4%***
Nat'l Science Foundation	2,568	2,857	2,946	3,038	3,131	3,229	25.8%	**13.1%**
Agriculture	1,553	1,549	1,561	1,552	1,555	1,556	0.1%	**-9.9%**
Commerce	1,081	1,083	1,096	1,096	1,105	1,077	-0.4%	**-10.4%**
Interior	609	629	632	624	623	623	2.5%	**-7.8%**
Transportation	676	775	816	774	727	700	3.6%	**-6.8%**
Environ. Protection Agency	672	657	667	724	754	776	15.4%	**3.8%**
All Other	1,536	1,640	1,631	1,646	1,658	1,675	9.1%	**-1.9%**
Total R&D	76,038	77,735	76,326	76,463	78,627	81,696	7.4%	**-3.4%**
Defense R&D	40,409	40,289	38,091	37,073	37,702	38,587	-4.5%	**-14.1%**
Nondefense R&D	35,629	37,446	38,235	39,390	40,925	43,108	21.0%	**8.8%**
"FS&T"	45,557	47,057	47,930	49,052	50,778	53,128	16.6%	**4.9%**

Source: AAAS analyses of defense and nondefense R&D. The analyses, containing agency details and methodology, are available on the World Wide Web at: http://www.aaas.org/spp/dspp/rd/rdwwwpg.htm

Table II-1. R&D in the FY 1999 Budget by Agency
(budget authority in millions of dollars)

	FY 1997 Actual	FY 1998 Estimate	FY 1999 Budget	Change FY 98-99 Amount	Change FY 98-99 Percent
Total R&D (Conduct and Facilities)					
Defense (military)	37,238	37,430	**37,010**	-420	-1.1%
Science & Tech. (6.1-6.3)	*7,493*	*7,800*	***7,181***	*-619*	*-7.9%*
All Other DOD R&D	*29,745*	*29,630*	***29,829***	*199*	*0.7%*
Health and Human Services	12,912	13,809	**14,888**	1,079	7.8%
Nat'l Institutes of Health	*12,217*	*13,097*	***14,163***	*1,066*	*8.1%*
NASA	9,352	9,816	**9,504**	-312	-3.2%
Energy	6,217	6,288	**7,142**	854	13.6%
Nat'l Science Foundation	2,424	2,568	**2,857**	290	11.3%
Agriculture	1,556	1,553	**1,549**	-4	-0.3%
Commerce	964	1,081	**1,083**	2	0.2%
Interior	591	609	**629**	21	3.4%
Transportation	612	676	**775**	99	14.6%
Environ. Protection Agency	595	672	**657**	-15	-2.3%
Veterans Affairs	588	608	**670**	62	10.2%
Education	185	209	**265**	56	26.8%
Agency for Int'l Develop.	169	150	**154**	4	2.7%
Smithsonian	142	146	**155**	9	6.2%
Tennessee Valley Auth.	52	37	**35**	-2	-5.4%
Labor	35	71	**33**	-38	-53.5%
Nuclear Reg. Comm.	62	61	**53**	-8	-13.1%
Corps of Engineers	44	42	**40**	-2	-4.8%
Housing and Urban Dev.	34	37	**50**	13	35.1%
Justice	48	65	**60**	-5	-7.7%
Social Security	8	18	**30**	12	66.7%
Postal Service	68	56	**59**	3	5.4%
Int'l Security Assist.	21	21	**21**	0	0.0%
Treasury	13	13	**13**	0	0.0%
Arms Ctrl. & Disarm.	1	1	**1**	0	0.0%
Marine Mammal Com.	1	1	**1**	0	0.0%
Total R&D	73,934	76,038	77,735	1,697	2.2%
Defense R&D	40,047	40,409	**40,289**	-120	-0.3%
Nondefense R&D	33,886	35,629	**37,446**	1,817	5.1%
"FS&T" [1]	43,340	45,557	**47,057**	1,500	3.3%

Table II-1 (continued). R&D in the FY 1999 Budget by Agency
(budget authority in millions of dollars)

	FY 1997	FY 1998	FY 1999	Change FY 98-99	
	Actual	Estimate	**Budget**	Amount	Percent
Conduct of R&D					
Defense (military)	37,116	37,295	**36,891**	-404	-1.1%
Science & Tech. (6.1-6.3)	*7,493*	*7,800*	***7,181***	*-619*	*-7.9%*
All Other DOD Conduct	*29,623*	*29,495*	***29,710***	*215*	*0.7%*
Health and Human Services	12,687	13,577	**14,639**	1,062	7.8%
Nat'l Institutes of Health	*11,994*	*12,867*	***13,915***	*1,048*	*8.1%*
NASA	9,038	9,529	**9,184**	-345	-3.6%
Energy	5,443	5,485	**6,195**	710	12.9%
Nat'l Science Foundation	2,248	2,357	**2,655**	298	12.6%
Agriculture	1,384	1,431	**1,470**	39	2.7%
Commerce	918	929	**984**	55	5.9%
Interior	582	601	**622**	21	3.5%
Transportation	591	656	**757**	101	15.4%
Environ. Protection Agency	570	641	**636**	-5	-0.9%
Veterans Affairs	267	276	**304**	28	10.1%
Education	185	206	**255**	49	23.8%
Agency for Int'l Develop.	169	150	**154**	4	2.7%
Smithsonian	137	141	**149**	8	5.7%
Tennessee Valley Auth.	52	37	**35**	-2	-5.4%
Labor	35	71	**33**	-38	-53.5%
Nuclear Reg. Comm.	62	61	**53**	-8	-13.1%
Corps of Engineers	44	42	**40**	-2	-4.8%
Housing and Urban Dev.	34	37	**50**	13	35.1%
Justice	48	65	**60**	-5	-7.7%
Social Security	8	18	**30**	12	66.7%
Postal Service	68	56	**59**	3	5.4%
Int'l Security Assist.	21	21	**21**	0	0.0%
Treasury	13	13	**13**	0	0.0%
Arms Ctrl. & Disarm.	1	1	**1**	0	0.0%
Marine Mammal Com.	1	1	**1**	0	0.0%
Total Conduct of R&D	71,723	73,697	**75,290**	1,593	2.2%
Defense	39,591	39,871	**39,699**	-172	-0.4%
Nondefense	32,132	33,826	**35,591**	1,765	5.2%

Table II-1 (continued). R&D in the FY 1999 Budget by Agency
(budget authority in millions of dollars)

	FY 1997 Actual	FY 1998 Estimate	**FY 1999 Budget**	Change FY 98-99 Amount	Change FY 98-99 Percent
R&D Facilities and Capital Equipment (no R&D facilities for agencies not shown)					
Defense (military)	122	135	**119**	-16	-11.9%
Health and Human Services	225	232	**249**	17	7.3%
Nat'l Institutes of Health	*223*	*230*	***248***	*18*	*7.8%*
NASA	313	287	**320**	33	11.4%
Energy	775	803	**948**	144	18.0%
Nat'l Science Foundation	177	211	**202**	-8	-4.0%
Agriculture	172	123	**80**	-43	-35.2%
Commerce	46	152	**100**	-52	-34.4%
Interior	9	7	**7**	0	0.0%
Transportation	21	20	**18**	-2	-10.0%
Environ. Protection Agency	25	31	**21**	-10	-32.3%
Veterans Affairs	321	332	**366**	34	10.2%
Education	0	3	**10**	7	233.3%
Smithsonian	5	5	**6**	1	20.0%
Total R&D Facils.	2,210	2,341	**2,445**	104	4.5%
Defense	456	538	**590**	52	9.7%
Nondefense	1,755	1,803	**1,855**	52	2.9%

Source: AAAS, based on OMB data for R&D for FY 1999, agency budget justifications, and information from agency budget offices.

Note: The projected inflation rate between FY 1998 and FY 1999 is 2.0 percent.

[1] An alternative measure for the federal investment in science and technology proposed by the National Academy of Sciences. This measure includes all federal R&D except for advanced development, testing and evaluation work in DOD and DOE. See Chapter 6.

Table II-2. R&D in the Department of Defense
(budget authority in millions of dollars)

	FY 1997 Actual	FY 1998 Estimate	FY 1999 Budget	Change FY 98-99 Amount	Change FY 98-99 Percent
Research, Development, Test, and Evaluation (RDT&E)					
Basic Research ("6.1")	1,032	1,042	**1,111**	69	6.7%
Applied Research ("6.2")	2,822	2,996	**3,020**	24	0.8%
Total Research	3,854	4,038	**4,131**	93	2.3%
Adv. Tech. Development ("6.3")	3,639	3,762	**3,050**	-712	-18.9%
Total Science & Technology [1]	7,493	7,800	**7,181**	-619	-7.9%
Demons. and Valid. ("6.4")	5,864	6,397	**6,516**	120	1.9%
Engineering and Manufacturing Development ("6.5")	8,536	8,199	**7,987**	-213	-2.6%
Management Support ("6.6")	3,465	3,199	**2,771**	-428	-13.4%
Operational Sys. Dev. ("6.7")	11,145	11,064	**11,624**	560	5.1%
BA Adjustment	-99	-59	**0**	60	-100.7%
Total RDT&E	36,404	36,600	**36,079**	-521	-1.4%
Other Appropriations [2]	834	830	**931**	101	12.2%
Total DOD R&D	37,238	37,430	**37,010**	-420	-1.1%
Total Conduct of R&D	37,116	37,295	**36,891**	-404	-1.1%
Total R&D Facilities & Equip.	122	135	**119**	-16	-11.9%

Source: OMB data for R&D for FY 1999, *Budget of the United States Government FY 1999*, and DOD "RDT&E Programs" (R-1).
[1] This represents DOD's contribution to the "FS&T" budget (see Chapter 6).
[2] R&D support in military personnel, military construction, and other appropriations.
Character of work ("6.x" categories) are expressed in total obligational authority (TOA).
BA Adjustment converts TOA into budget authority.

DOD Military Budget (in BILLIONS of dollars budget authority)

	FY 1997 Actual	FY 1998 Estimate	FY 1999 Budget	Change FY 98-99 Amount	Change FY 98-99 Percent
RDT&E (see above)	36.4	36.6	**36.1**	-0.5	-1.4%
Military Personnel	70.3	69.7	**70.8**	1.1	1.6%
Operations and Maintenance	92.3	94.4	**94.8**	0.4	0.4%
Procurement	42.9	44.8	**48.7**	3.9	8.7%
Military Construction	5.7	5.1	**4.3**	-0.8	-15.5%
Family Housing	4.1	3.8	**3.5**	-0.3	-8.7%
Revolving and Management Funds	7.7	2.0	**0.6**	-1.5	-71.1%
Allowances and Offsets	-1.5	-1.5	**-1.5**	0.0	-2.2%
Total DOD Budget	258.0	254.9	**257.3**	2.4	0.9%

DOD military budget only (excludes civilian activities of the Corps of Engineers).

Table II-11. R&D in the Department of Energy
(budget authority in millions of dollars)

	FY 1997 Actual	FY 1998 Estimate	FY 1999 Budget	Change FY 98-99 Amount	Change FY 98-99 Percent
Summary of DOE R&D (see notes at end of table):					
1. Energy Supply [1]	583.8	550.4	**709.0**	158.6	28.8%
2. Science [1]	2,220.8	2,228.2	**2,445.2**	217.1	9.7%
3. Fossil Energy	286.6	276.1	**295.0**	18.9	6.9%
4. Energy Conservation	319.1	355.8	**454.6**	98.8	27.8%
5. Atomic Energy Defense	2,809.2	2,978.6	**3,278.6**	300.0	10.1%
6. Clean Coal Technology [2]	-2.1	-101.0	**-40.0**	- -	- -
Total DOE R&D	6,217.4	6,288.1	**7,142.4**	854.3	13.6%
1. Energy Supply [1] (does not include non-R&D components)					
Solar and Renewable Energy	237.1	266.9	**356.8**	89.9	33.7%
Nuclear Energy	130.3	61.4	**130.7**	69.3	112.9%
Fusion Energy Sciences	216.4	222.1	**221.5**	-0.6	-0.3%
Total Energy Supply R&D [1]	583.8	550.4	**709.0**	158.6	28.8%
2. Science [1] (does not include non-R&D components)					
High-Energy Physics	657.1	673.0	**686.0**	13.1	1.9%
Nuclear Physics	310.0	319.8	**332.6**	12.8	4.0%
Basic Energy Sciences					
Materials Sciences	368.5	391.0	**417.2**	26.2	6.7%
Chemical Sciences	194.5	200.7	**209.6**	8.9	4.4%
Engineering & Geosciences	40.9	41.2	**44.4**	3.2	7.8%
Energy Biosciences	27.3	27.4	**32.5**	5.1	18.5%
Equipment & Construction [4]	11.5	7.0	**132.4**	125.4	1791.4%
Adjustment	-9.7	-4.8	**0.0**	4.8	-100.0%
Total BES	633.0	662.5	**836.1**	173.6	26.2%
Computational and Technology Research					
Math., Info. and Compu. Sci.	114.8	127.2	**141.3**	14.1	11.1%
Laboratory Technology Res.	23.7	15.8	**16.3**	0.5	3.4%
Advanced Energy Projects	11.4	7.6	**3.0**	-4.6	-60.4%
Adjustment	-2.6	-1.7	**0.0**	1.7	-100.0%
Total CTR	147.3	148.9	**160.6**	11.8	7.9%

Table II-11 (continued). R&D in the Department of Energy
(budget authority in millions of dollars)

	FY 1997 Actual	FY 1998 Estimate	FY 1999 Budget	Change FY 98-99 Amount	Change FY 98-99 Percent
Biological and Environmental Research					
Life Sciences	143.5	165.2	**162.0**	-3.2	-1.9%
Environmental Processes	109.1	108.4	**119.2**	10.8	10.0%
Environmental Remediation	34.9	66.3	**67.4**	1.1	1.7%
Medical Apps./ Measurement	56.6	66.0	**43.9**	-22.1	-33.4%
Construction	36.1	0.0	**0.0**	0.0	- -
Adjustment	-6.7	-4.4	**0.0**	4.4	-100.0%
Total BER	373.5	401.5	**392.6**	-8.9	-2.2%
Energy Research Analyses	1.5	1.3	**1.0**	-0.3	-24.7%
Univ. & Science Education	0.0	0.0	**15.0**	15.0	- -
Small Bus. Innov. Research	79.2	0.0	**0.0**	0.0	- -
Multiprogram Lab Support	19.2	21.2	**21.3**	0.1	0.4%
Total Science [1]	2,220.8	2,228.2	**2,445.2**	217.1	9.7%
3. Fossil Energy R&D (does not include non-R&D components)					
Coal	100.9	107.4	**130.0**	22.6	21.1%
Petroleum	45.2	48.6	**50.2**	1.6	3.3%
Gas	117.3	111.2	**109.6**	-1.7	-1.5%
Cooperative R&D	5.4	5.8	**5.8**	0.0	-0.1%
Other R&D programs	7.0	7.5	**7.6**	0.1	1.4%
Adjustments and deduct non-R&	10.8	-4.4	**-8.2**	-3.8	84.7%
Total Fossil Energy R&D	286.6	276.1	**295.0**	18.9	6.9%
4. Energy Conservation (does not include non-R&D components)					
Building Technologies	80.1	78.8	**126.4**	47.7	60.5%
Industrial Technologies	115.4	136.2	**166.6**	30.4	22.3%
Transportation Technologies	172.5	193.3	**246.1**	52.8	27.3%
Adjustments and deduct non-R&	-48.9	-52.4	**-84.5**	-32.1	61.2%
Total Energy Conservation	319.1	355.8	**454.6**	98.8	27.8%
5. Atomic Energy Defense Activities (does not include non-R&D components)					
Weapons Activities					
Stockpile Stewardship					
ASCI *	151.6	223.5	**329.1**	105.6	47.2%

Table II-11 (continued). R&D in the Department of Energy
(budget authority in millions of dollars)

	FY 1997 Actual	FY 1998 Estimate	FY 1999 Budget	Change FY 98-99 Amount	Change FY 98-99 Percent
Other Programs and Initiatives	220.0	231.7	**300.8**	69.2	29.9%
Core Res. and Adv. Tech.	557.1	593.7	**645.9**	52.2	8.8%
Testing Capab. & Readiness	166.0	180.4	**183.9**	3.5	1.9%
Core Steward. Equip. & Const	129.6	150.6	**161.7**	11.1	7.3%
Inertial Confinement Fusion	234.6	215.7	**213.8**	-1.9	-0.9%
National Ignition Facility	131.9	197.8	**284.2**	86.4	43.7%
Tech. Partnerships and Edu.	69.4	64.8	**69.0**	4.2	6.4%
Adjustment	-3.4	-0.5	**0.0**	0.5	-100.0%
Total Stockpile Stewardship	1,656.8	1,857.8	**2,188.4**	330.6	17.8%
Other Weapons Activities R&D	33.4	31.9	**73.6**	41.7	130.5%
Total Weapons Activities R&	1,690.2	1,889.7	**2,262.0**	372.3	19.7%
Naval Reactors	681.9	670.5	**665.5**	-5.0	-0.7%
Nonproliferation & Verification	211.9	210.0	**210.0**	0.0	0.0%
Nuclear Safeguards & Security	24.0	23.6	**23.6**	0.0	0.0%
Environmental Management	197.5	180.3	**113.0**	-67.3	-37.3%
Intelligence	3.7	4.5	**4.5**	0.0	0.0%
Total Atomic Defense R&D	2,809.2	2,978.6	**3,278.6**	300.0	10.1%
6. Clean Coal Technology [2]	-2.1	-101.0	**-40.0**	- -	- -
Total DOE R&D	6,217.4	6,288.1	**7,142.4**	854.3	13.6%
Conduct of R&D	5,442.7	5,484.7	**6,194.8**	710.1	12.9%
R&D Facilities	774.7	803.4	**947.6**	144.3	18.0%
DOE "FS&T" [3]	5,369.5	5,437.2	**6,293.0**	855.8	15.7%

Source: Agency budget justification and agency supporting documents.

* - Accelerated Strategic Computing Initiative.

[1] DOE has changed its appropriation account structure. Programs in the General Science and Research account and selected programs in Energy Supply have been shifted to a new "Science" account. The table shows DOE programs under the new account structure.

[2] Negative because of rescissions and deferrals of previously appropriated funds.

[3] DOE contribution to the "FS&T" budget. Please see Chapter 6.

[4] Includes $128 million in FY 1999 for the National Spallation Neutron Source.

Table II-11. Department of Energy R&D

Department of Energy Budget (budget authority in millions of dollars)

	FY 1997 Actual	FY 1998 Estimate	FY 1999 Budget	Change FY 98-99 Amount	Change FY 98-99 Percent
Weapons Activities	3,911	4,147	**4,500**	353	8.5%
Defense Environmental Restoration	4,398	4,296	**4,260**	-37	-0.9%
Defense Facilities Closure Projects	862	996	**1,006**	10	1.0%
EM Privatization	330	200	**517**	317	158.4%
Nuclear Waste and Other Defense	1,829	1,829	**1,857**	28	1.6%
Total DOE Defense	11,331	11,468	**12,140**	672	5.9%
Science	2,267	2,236	**2,482**	247	11.0%
Energy Supply	944	1,024	**1,129**	105	10.3%
Fossil Energy	359	362	**383**	21	5.8%
Energy Conservation	534	591	**774**	182	30.9%
Other Energy Programs	165	40	**290**	250	622.1%
Non-defense Environmental Mngm	572	494	**462**	-32	-6.5%
Power Marketing Administrations	223	230	**235**	4	1.9%
Departmental Administration & IG	154	115	**139**	24	20.7%
Total DOE Budget	16,547	16,561	18,035	1,474	8.9%

Source: Department of Energy budget justification.

DOE appropriations only (does not include offsets and mandatory).

Includes R&D and non-R&D components.