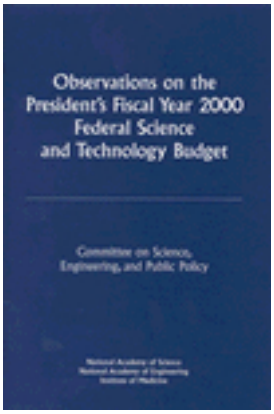

Observations on the President's Fiscal Year 2000 Federal Science and Technology Budget

Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, Institute of Medicine

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Committee on Science, Engineering, and Public Policy

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Preface

In 1995, the National Academy of Sciences (NAS)-National Academy of Engineering (NAE)-Institute of Medicine (IOM)-National Research Council (NRC) issued a report titled *Allocating Federal Funds for Science and Technology*. The report recommended development of a federal science and technology (FS&T) budget that would reflect the federal investment in the creation of new knowledge and technologies and exclude such activities as testing and evaluation of new weapons systems. An NAS panel later issued a series of reports that assessed the FS&T budget.

In 1998, the Committee on Science, Engineering, and Public Policy (COSEPUP), a joint committee of NAS, NAE, and IOM, issued its first assessment of the FS&T budget. To avoid duplicate quantitative analysis of the budget with COSEPUP, the American Association for the Advancement of Science (AAAS), in cooperation with the Academies, agreed in 1998 to add a quantitative analysis of the FS&T budget to its annual assessment.

COSEPUP's assessment of the FS&T budget is now a part of the annual AAAS R&D report. This year's assessment is chapter 6 of AAAS's Intersociety Working Group report, *AAAS Report XXIV: Research and Development FY 2000*. The AAAS report provides a one-stop assessment of the research budget and is useful to those interested in our nation's investment in research.

This report has been reviewed by persons chosen for their diverse perspectives and technical expertise in accordance with procedures approved by the National Research Council's Report Review Committee. The purposes of the independent review are to provide candid and critical comments that will assist COSEPUP in making its report as sound as possible and to ensure that the report

meets institutional standards of objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their participation in the review of this report: Jack Gibbons, Mary Good, Christopher Hill, Stephen Kohashi, Kei Koizumi, John Mayo, Al Teich, and the report review coordinator, Gerry Dinneen.

The production of this report was the result of the hard work of the committee as a whole and of the extra efforts of the Guidance Group chaired by James Duderstadt. The project was aided by the invaluable help of COSEPUP professional staff—Anne-Marie Mazza, study director; Peter Henderson, program officer; Brett Willette, research associate; and editor Norman Grossblatt.

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

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Observations on the President's FY 2000 Federal Science and Technology Budget

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) 2000 submission that reflects the portion of the federal research and development budget that is aimed at investment in the creation of new knowledge and technologies.

Provided below are the highlights of the FS&T budget:

- In constant FY 1999 dollars,[1] the President's budget request would increase FS&T investments by just 0.4 percent from FY 1999 to FY 2000. In current dollars the President's budget represents a 2.4 percent increase from $48.3 billion in FY 1999 to $49.4 billion in FY 2000.
- FS&T funding for both the National Institutes of Health (NIH) and the National Science Foundation (NSF) has increased substantially since 1994 on a constant dollar basis. NIH's FY 2000 budget ($15.3 billion) would be largely unchanged from FY 1999 but would be 31.2 percent higher than in FY 1994. NSF's $2.9 billion FY 2000 budget would be 4.4 percent higher than in FY 1999 and 15.8 percent higher than in FY 1994. FS&T funding in the Department of Energy ($6.6 billion) remains about the same in constant dollars as the FY 1994 budget.

[1] All constant dollars are FY 1999 dollars. The GDP deflator, which is about 2.2 percent per year in the 1994-1999 period, 2.0 percent per year for FY 1999–FY 2000, and 2.1% for FY2001–FY2004, is used by both COSEPUP and AAAS in calculating constant FY 1999 dollar figures.

- The FS&T budget in FY 2000 would be 3.3 percent more than in FY 1994 in constant dollars. However, if NIH is excluded, the FY 2000 FS&T budget would decrease by 5.7 percent from FY 1994.
- In FY 2000, the Department of Defense (DOD) FS&T budget of $7.4 billion would be 19.8 percent less in constant dollars than in FY 1994.
- From FY 1999 to FY 2000, support for research and development at colleges and universities would increase by 0.3 percent in constant dollars. In FY 2000, support for research and development at colleges and universities would increase substantially (16.6 percent) in constant dollars from FY 1997. However, when HHS is excluded, support to colleges and universities would only increase slightly (1.9 percent) since FY 1997. DOD support for research and development at colleges and universities would continue to decrease, with support down by 31.7 percent since FY 1997.
- From FY 1993 to FY 1998, federal obligations for research in the physical sciences decreased by 11.2 percent in constant dollars and for engineering increased by only 0.4 percent. It appears that budgets for mission agencies for FY 1999 and FY 2000 would continue this trend.
- The President's budget proposes $366 million in new funding for Information Technology for the 21st Century which directs funding toward fundamental, long-term research, advanced applications, and research on the economic and social implications of information technology. This initiative is part of the overall $1.8 billion federal investment in information technology.
- Under this year's budget proposal, several smaller R&D agencies would receive increased funding: the U.S. Department of Education would receive $25 million for research on primary education; the U.S. Department of Agriculture's Cooperative State Research, Education, and Extension Service would receive $200 million for the National Research Initiative (NRI); and the U.S. Department of Transportation's Highway Research and Deployment Initiative would receive $390 million.
- The budget provides $2.4 billion to extend the Research and Experimentation Tax Credit until June 30, 2000.
- The President's $38.1 billion 21st Century Research Fund is based on the FS&T budget concept and this year includes DOD basic and applied research programs. However, differences remain between both budget concepts in terms of the level of funding and the activities funded across all agencies.

THE FY 2000 FS&T BUDGET

In 1995, the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council issued a report titled,

Allocating Federal Funds for Science and Technology, which recommended development of a federal science and technology (FS&T) budget that would reflect the federal investment in the creation of new knowledge and technologies and exclude such activities as testing and evaluation of new weapons systems.

This year OMB provides information on the President's proposed R&D budget and a proposed 21st Century Research Fund. As shown in Figure 1, the R&D budget in FY 2000 would be $77.9 billion, the FS&T budget $49.4 billion, and the 21st Century Research Fund $38.1 billion. (For additional information on the three budgets, see appendix A.)

The R&D budget incorporates all basic and applied research, and development 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 production (RDT&E). Funding for R&D facilities includes construction, repair, and alteration of physical plant (reactors, wind tunnels, particle accelerators, and laboratories) used in the conduct of R&D. It also includes major capital 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.)

The FS&T budget includes the civilian and noncivilian research budgets 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 of the DOE atomic-energy defense program are included in the FS&T budget. In addi-

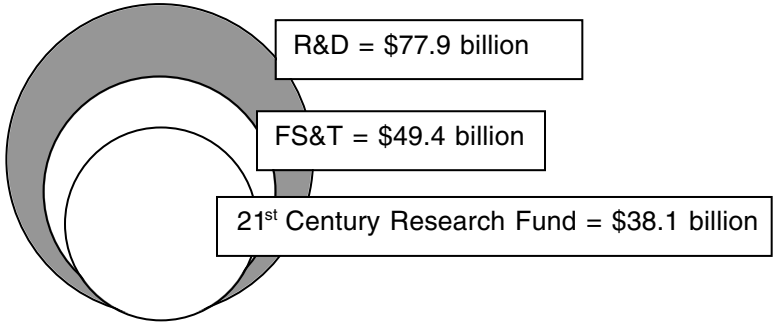

FIGURE 1 FY 2000 R&D, FS&T, and 21st Century Research Fund.

tion, the FS&T budget includes R&D facilities and major capital equipment for R&D.

The President's $49.4 billion for FS&T in the budget for FY 2000 constitutes an increase of just 0.4 percent from FY 1999 in constant dollars and represents little change in the nation's investment in the creation of new knowledge and technologies (see Figure 2). Funding for science and technology continues to compete with other discretionary programs under the spending caps signed into law in 1997. For FY 2000, there is one cap of $537 billion for all discretionary spending, rather than separate caps for defense and non-defense appropriations as in the past. The President's budget proposes $555 billion in discretionary spending, exceeding the cap. To meet the cap, the Administration proposes $18 billion in offsets, such as a new 55-cent a pack cigarette tax.

This year, the $38.1 billion 21st Century Research Fund is the centerpiece of the President's R&D investment strategy and grows by 3 percent in FY 2000. The 21st Century Research Fund is similar in concept to an integrated FS&T budget with the inclusion of DOD basic and applied research, although the two budgets differ somewhat across all agencies in terms of the level of funding and the activities funded. For example, the FS&T budget includes DOD "6.3" and DOE's atomic weapons science activities whereas the 21st Century Fund does not (see appendix A, table A-1).

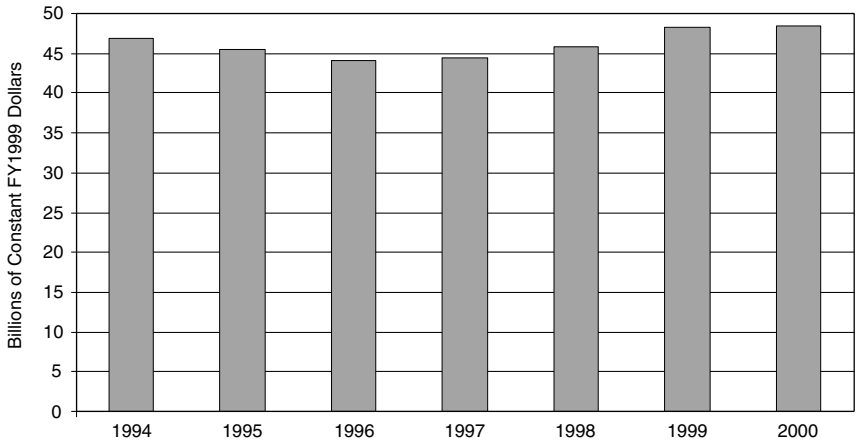

FIGURE 2 FS&T Budget, FY 1994–FY 2000 (Budget Authority in billions of Constant FY 1999 Dollars).

HEALTH OF THE NATION'S RESEARCH PORTFOLIO

Current projections of the FS&T budget indicate a 7.0 percent decline in constant dollars from FY 1999 to FY 2004, according to AAAS analysis of the outyear projections of the FY 2000 budget (see appendix B). If the projections hold, they pose serious problems for the overall health of the nation's research enterprise.

Of additional concern, is the future allocation of funding by field. As Figure 3 indicates, HHS receives almost 50 percent of the federal investment in basic research, most of which is concentrated in the life sciences. Funding for the physical sciences relies heavily on DOD, NASA, and DOE, which together provide 33 percent of the federal funding for basic research. Additionally, DOD provides a large fraction of all computer science research funding and graduate education support. Because of its relatively small size, increases at NSF cannot compensate for the significant decreases at DOD or the other mission agencies.

The downward trend at DOD could lead to a gradual erosion of such fields of research as the physical sciences and engineering, thus weakening the research enterprise. From FY 1993 to FY 1998, federal obligations for research in the physical sciences decreased by 11.2 percent and increased by only 0.4 percent in engineering, in constant dollars. It appears that the FY 1999 and FY 2000 budgets for mission agencies that support these fields, such as DOD, NASA, and DOE would continue this trend.

The federal science and technology budget must provide a balanced invest-

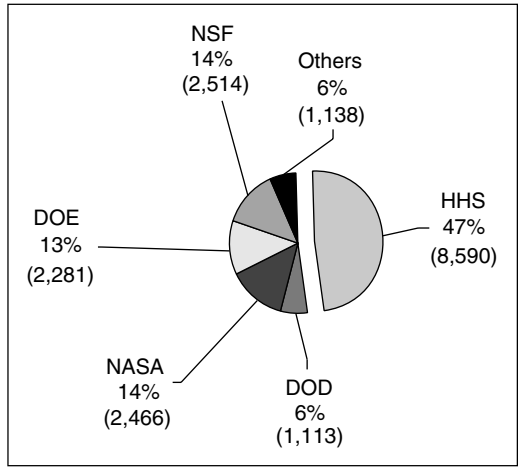

FIGURE 3 Percentage of Total Federal Spending on Basic Research by Agency, FY 2000 (funding in millions of dollars).

ment strategy in order for the nation to benefit from all of its investments. It can be expected that as new discoveries are made, new venues of research will be opened and old ones closed or reduced. Reductions in any broad field must be made in the context of the overall research portfolio. Continuing the current distribution of appropriations could distort the nation's research portfolio with adverse long-term consequences for our country. While the results of funding for basic research cannot be predicted, history shows us that basic research in science and engineering leads to unexpected and important outcomes. Often outcomes in one field lead to advances in another field. For example, discoveries in the physical sciences led to development, many years later, of magnetic resonance imaging, an important breakthrough in the biomedical sciences. The nation must be positioned to benefit from the numerous opportunities that the life sciences offer as well as ensure that all broad fields of science and engineering remain vital.

SUPPORT FOR RESEARCH AND DEVELOPMENT AT COLLEGES AND UNIVERSITIES

Federal support for research and development at colleges and universities is a hallmark of the U.S. science and engineering enterprise. Under the President's FY 2000 budget, support for research and development at colleges and universities is essentially flat in constant dollars, up just 0.3 percent from FY 1999. In constant dollars, support for research and development at colleges and universities would be up 16.6 percent from FY 1997 to FY 2000. (Statistics presented here are for research and development. However, the vast majority of these funds are in the FS&T budget because basic and applied research alone comprises $10.7 billion of the $12.7 billion of R&D support for colleges and universities in 1997 and $10.9 billion of the $13.7 billion in 1998.)

When HHS is excluded, however, support for research and development at colleges and universities would increase only slightly.[2] The increase in support from FY 1997 to FY 2000 without NIH is only 6.6 percent, and in constant dollars it is only 1.9 percent. DOD support for research and development at colleges and universities would continue a downward trend with a decrease from FY 1997 of 28.5 percent and a 31.7 percent decrease in constant dollars from FY 1997 to FY 2000. DOD provides a major part of the support for such fields as engineering, material science, computer science, and mathematics, so the substantial decrease in DOD FS&T funding could pose serious problems for the health of the nation's research university enterprise (see Table 1).

[2] NIH provides 99 percent of HHS support for research and development at colleges and universities.

TABLE 1 Federal Obligations for Research and Development at Colleges and Universities (in millions of constant FY 1999 dollars)

All federal agencies					
Fiscal Year	1997 Actual	1998 Actual	1999 Estimated	2000 Proposed	percent Change FY 1997-FY 2000
Current $	12,701	13,710	15,133	15,486	21.9
Constant $	13,020	13,888	15,133	15,182	16.6
All agencies except the Dept. of Health and Human Services					
Fiscal Year	1997 Actual	1998 Actual	1999 Estimated	2000 Proposed	percent Change FY 1997-FY 2000
Current $	5,554	5,516	5,653	5,920	6.6
Constant $	5,693	5,588	5,653	5,804	1.9
Department of Defense only					
Fiscal Year	1997 Actual	1998 Actual	1999 Estimated	2000 Proposed	percent Change FY 1997-FY 2000
Current $	1,310	1,053	931	936	–28.5
Constant $	1,343	1,067	931	918	–31.7

Source: Figures for 1998-2000 from AAAS, Table I-7; figures for 1997 carried forward from *Observations on the President's FY 1999 Federal Science & Technology Budget.*

INFORMATION TECHNOLOGY FOR THE 21ST CENTURY

A major priority of the President's FY 2000 budget is Information Technology for the 21st Century. This initiative, which will be led by NSF ($146 million), DOE ($70 million), and DOD ($100 million), will provide $366 million in new funding for long-term fundamental research in computing and communications, development of a new generation of supercomputers and infrastructure for computer simulation and modeling applications, research on the social and economic implications of information technology, and workforce training. The initiative represents a 28 percent increase in the government's investment in information technology research (see Table 2).

At NSF, the Computer and Informational Science and Engineering (CISE) Directorate would receive $110 million of NSF's $146 million. This investment in CISE represents a 41 percent increase over FY 1999 and a 57 percent increase over FY 1998 (current dollars). At DOE, the initiative would increase funding for scientific applications, computer science and enabling technology, and scientific

TABLE 2 Information Technology for the 21st Century, by Agency and Category of Spending, FY 2000 (millions)

Agency	Fundamental Information Technology Research	Advanced Computing for Science & Engineering	Ethical, Legal and Social Implications and Workforce Programs	Total
DOD	100	0	0	100
DOE	6	62	2	70
NASA	18	19	1	38
NIH	2	2	2	6
NOAA	2	4	0	6
NSF	100	36	10	146
Total	228	123	15	366

Source: Office of Management and Budget, *Budget of the U.S. Government FY 2000*.

simulation infrastructure. The DOD portion of the initiative increases funding to computer sciences. DOD plans to allocate some of the funds to the existing University Research Initiative. In addition, funds will go to DARPA and ARDA (a new DOD intelligence program known as the Advanced Research and Development Activity in Information Technology).

SMALLER R&D AGENCIES

Under this year's budget proposal, several smaller R&D agencies would receive increased funding. The Department of Education would receive $25 million for the agency's contribution from the Education Research Initiative, a collaborative activity with NSF directed at large-scale research focused on the best approaches to raising student achievement in K-3. The Department of Agriculture's Cooperative State Research, Education, and Extension Service would receive $200 million for the National Research Initiative (NRI) which provides competitive research grants. The Department of Transportation's Highway Research and Deployment Initiative would receive a $228 million increase over FY 1999 to support such activities as improving the durability of pavement and bridges, enhancing pedestrian safety, and refining air-quality analysis models.

RESEARCH AND EXPERIMENTATION TAX CREDIT

The President's budget provides $2.4 billion to extend the Research and Experimentation Tax Credit until June 30, 2000. The Administration believes the

tax credit "helps stimulate additional private sector investment in research and development which encourages technological advancement, leading to higher productivity, and helping to generate new American jobs."[3]

CONCLUSION

In conclusion, an analysis of the FS&T portion of the President's FY 2000 R&D budget shows a slight increase in the federal science and technology research investment from FY 1999. Of particular concern is the effect of decreased funding at DOD for research and development at colleges and universities and, specifically, the effect on academic research in the physical sciences and engineering.

Since 1994, NIH and NSF have received increased funding in real terms. Increases at NIH allow our nation to benefit from the extraordinary opportunities presented in the life sciences. However, successful results from increased funding for NIH depend on the health of the physical and mathematical sciences, as well as that of other fields. The nation must recognize the importance of investing in a balanced way across a broad range of fields to maintain the overall health of the science and technology portfolio. Recent increases in NSF funding cannot begin to compensate for the declines in funding of mission agencies. Such an unbalanced investment strategy will undermine two primary goals of our national research enterprise: that the United States perform at least at world-class levels in all major fields of science and engineering and that the United States should seek preeminence in a select number of fields.[4]

For more information, see the COSEPUP Web site at
http://www2.nas.edu/cosepup

[3] *Research and Development Budget: Investments for the Twenty-First Century, February 1999, p. 2.*

[4] See *Science, Technology, and the Federal Government: National Goals for a New Era*, COSEPUP, 1993; *Evaluating Federal Research Programs: Research and the Government Performance and Results Act*, COSEPUP, 1999.

APPENDIX A

FS&T Tables

TABLE A-1 Comparison of Alternative FY 2000 Budgets (millions of dollars)

Agency	21st Century Research Fund*	FS&T	R&D
Dept. of Defense	4,069	7,386	35,065
Dept. of Health & Human Services	15,933	16,047	16,047
National Institutes of Health	15,933	15,289	15,289
National Aeronautics and Space Administration	4,786	9,770	9,770
Dept. of Energy	3,881	6,645	7,467
National Science Foundation	3,921	2,890	2,890
Dept. of Agriculture	1,603	1,850	1,850
Dept. of Commerce	918	1,172	1,172
Dept. of the Interior	838	590	590
Dept. of Transportation	834	836	836
Environmental Protection Agency	751	645	645
All Others	581	1,578	1,578
TOTAL	38,115	49,409	77,910

Source: Office of Management and Budget, *Budget of the U.S. Government FY 2000* and AAAS, Tables II-1 and II-11.
*Of the $38.1 billion proposed for the 21st Century Research Fund, $1.94 billion is not included in either the R&D budget or the FS&T budget. More than half of the non-FS&T money in the 21st Century Fund ($1.03 billion) is due to the inclusion of almost all of the non-FS&T portions of the NSF budget in the 21st Century Fund (e.g., Education and Human Resources). The remainder is non-FS&T at NIH, Interior, and EPA.

TABLE A-2 Trends in FS&T and R&D, FY 1994-FY 2000, in Millions of Constant FY 1999 Dollars

	FS&T		R&D	
Fiscal Year	Current	Constant	Current	Constant
1994	43,002	46,894	71,074	77,507
1995	42,688	45,461	70,948	75,557
1996	42,162	44,038	71,206	74,374
1997	43,340	44,428	73,934	75,791
1998	45,191	45,777	75,879	76,863
1999	48,257	48,257	79,282	79,282
2000	49,410	48,441	77,910	76,382
Chg., FY 1999-FY 2000	2.4	0.4	–1.7	–3.7
Chg., FY 1994-FY 2000	14.9	3.3	9.6	–1.5

Source: AAAS Tables I-16 and II-1; FS&T figures for 1994-1997 carried forward from *Observations on the President's FY 1999 Federal Science and Technology Budget*.

APPENDIX B

AAAS Table

TABLE B-1 AAAS Analysis of the Outyear Projections for R&D in the FY 2000 Budget (budget authority in millions of dollars)

	FY 1999 Estimate	FY 2000 Budget	FY 2001 Projected	FY 2002 Projected	FY 2003 Projected	FY 2004 Projected	% Change current $	FY 99-04 **constant $**
Total R&D (Conduct and Facilities)								
Defense (military)	37,975	35,065	34,980	35,377	35,212	35,719	-5.9%	**–15.1%**
Health & Human Services	15,750	16,047	16,047	16,047	16,047	16,047	1.9%	**–8.1%**
Nat'l Institutes of Health	*14,971*	*15,289*	*15,289*	*15,289*	*15,289*	*15,289*	*2.1%*	***–7.9%***
NASA	9,715	9,770	9,873	9,860	9,848	9,834	1.2%	**–8.7%**
Energy	6,974	7,467	7,472	7,472	7,457	7,457	6.9%	**–3.5%**
Defense	*3,234*	*3,417*	*3,417*	*3,417*	*3,417*	*3,417*	*5.7%*	***–4.7%***
Nondefense	*3,740*	*4,049*	*4,054*	*4,054*	*4,039*	*4,039*	*8.0%*	***–2.6%***
Nat'l Science Foundation	2,714	2,890	2,948	2,931	2,905	2,907	7.1%	**–3.4%**
Agriculture	1,660	1,850	1,749	1,749	1,749	1,749	5.3%	**–5.0%**
Commerce	1,075	1,172	1,101	1,084	1,083	1,085	0.9%	**–8.9%**
Interior	499	590	590	590	590	590	18.2%	**6.7%**
Transportation	603	836	854	868	887	901	49.5%	**34.9%**
Environ. Protection Agcy.	669	645	645	645	645	645	–3.6%	**–13.0%**
All other	1,648	1,579	1,579	1,579	1,579	1,579	–4.2%	**–13.6%**
Total R&D	79,282	77,910	77,837	78,203	76,002	78,512	–1.0%	**–10.7%**
Defense R&D	41,208	38,483	38,397	38,795	38,630	39,137	–5.0%	**–14.3%**
Nondefense R&D	38,074	39,428	39,440	39,406	39,372	39,376	3.4%	**–6.7%**
FS&T	48,258	49,410	49,350	49,409	49,523	49,767	3.1%	**-7.0%**

Source: AAAS analyses of defense and nondefense R&D, based on detailed budget account projections in the Public Budget Database of the Budget of the United States Government FY 2000. FY 1999 figures represent latest agency estimates of R&D. FY 2000 figures represent latest revised agency requests. Constant dollar conversions based on GDP deflators from OMB.