1

Federal R&D in the FY 2009 Budget: An Introduction

Kei Koizumi, AAAS

AN OVERVIEW OF R&D IN THE FY 2009 BUDGET

On February 4, 2008, President Bush released his proposed budget for fiscal year (FY) 2009. The $3.1 trillion budget projects a deficit exceeding $400 billion next year, despite excluding most 2009 war costs and holding domestic spending flat. Within a flat domestic budget, the 2009 budget for R&D continues to propose large increases for the three physical sciences agencies in the American Competitiveness Initiative (ACI), increases for human spacecraft development, flat funding for biomedical research in the National Institutes of Health (NIH), and mostly increases for other parts of the federal research and development (R&D) portfolio but cuts to key environmental and agricultural R&D agencies. Defense R&D would continue to increase, and defense basic research in the physical sciences would share in the gains. Despite tough budget conditions, the overall federal investment in R&D would increase $4.9 billion or 3.4 percent to $147.4 billion (see Table I-1), driven primarily by increases in development funding. The federal investment in basic and applied research would fall 0.3 percent to $57.3 billion in 2009 as proposed gains in the ACI agencies would be offset by cuts in other agencies' research funding, primarily cuts in congressional earmarks (see Table II-1). Federal research funding would fall for the fifth year in a row in real dollars.

In its broad outlines, President Bush's proposed budget for FY 2009 once again offers the same themes as in previous years: big increases for defense and homeland security, trims in some entitlement programs, extensions of expiring tax cuts, and plans to reduce the budget deficit primarily by cutting domestic discretionary spending and by not budgeting for future war costs. There is also continuity in the President's proposals for the federal R&D portfolio: despite appropriations setbacks, the budget stays on track with the third year of the American Competitiveness Initiative (ACI) vision of doubling between 2006 and

2016 the budgets of the National Science Foundation (NSF), the Department of Energy (DOE) Office of Science, and the National Institute of Standards and Technology (NIST) laboratories in Commerce. The three research-oriented ACI agencies lead the pack in R&D gains (see Figure 1), followed closely by proposed gains for development programs in DOE, the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD; see Table II-1). But in other areas of the federal R&D portfolio, cuts in past budgets turn into requested increases this time around. While biomedical research in the National Institutes of Health (NIH) would remain flat, in a tight domestic budget most other R&D funding agencies would see gains. As a result, most federal R&D agencies would see real increases for their R&D programs if the budget is enacted, although there would be cuts to agricultural and environmental R&D agencies.

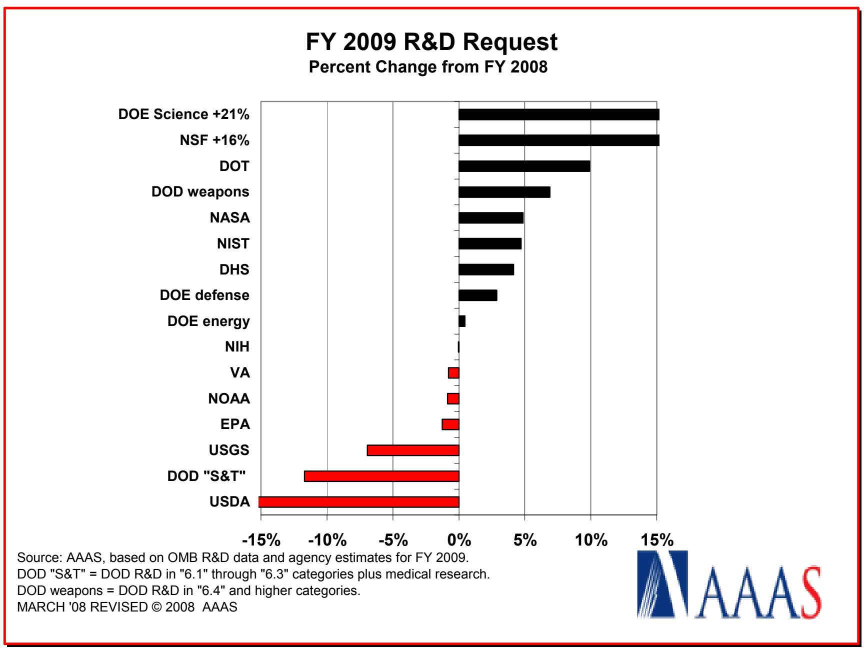

Figure 1.

- The proposed federal R&D portfolio in FY 2009 is a record $147.4 billion, $4.9 billion or 3.4 percent above this year's current funding level (see Table II-1). Once pending war-related supplementals for DOD development in 2008 and 2009 are added, federal R&D totals for both years will climb even higher.

- **Total federal support of research (basic and applied) would fall 0.3 percent** or $163 million to $57.3 billion, even after large proposed increases for physical sciences and related research in NSF, DOE's Office of Science, and NIST (see Table II-1). Removing 2008 congressional earmarks from the new budget request ($1.1 billion in research earmarks for DOD alone) accounts for the cut; excluding earmarks from the 2008 base, federal research spending in 2009 would increase by enough to keep pace with expected inflation of 2.0 percent. NIH basic and applied research funding would stay flat at $28.5 billion, while most other agencies would see gains in non-earmarked research funding. In real terms, the federal research portfolio would fall for the fifth year in a row and would be down 9.1 percent from 2004.

- **President Bush's American Competitiveness Initiative (ACI) would once again be the big winner among domestic programs.** The three ACI agencies (NSF, NIST laboratories, DOE Office of Science) would collectively receive $12.2 billion in the 2009 budget, a 15 percent increase over this year (see Table I-7; includes R&D and non-R&D). The NSF budget of $6.9 billion would be a 14 percent increase, with increases approaching 20 percent for the Mathematical and Physical Sciences (MPS), engineering, and computer science directorates and smaller increases for non-physical sciences directorates. DOE's Office of Science request for $4.7 billion would be a 19 percent increase restoring funding for physics, fusion, and other basic research projects hard hit by the 2008 appropriation. And the NIST labs would receive a large increase, though at the cost of proposed eliminations of NIST's external programs (the Technology Innovation Program and the Hollings Manufacturing Extension Partnership). In a surprising development, DOD requests a 4 percent increase in its basic research ("6.1") portfolio to $1.7 billion, a 16 percent boost if earmarks in the 2008 base are excluded. DOD is a key sponsor of the physical sciences, but until now physical sciences advocates have been unsuccessful in convincing DOD to boost this investment.

- The National Institutes of Health (NIH) would receive exactly the same amount ($29.5 billion) in 2009 as in 2008; nearly all of NIH's institutes and centers would also get the same budgets as this year. Several biomedical research advocacy organizations have already decried the 2009 proposal for leaving NIH 13 percent below the 2004 funding level after adjusting for biomedical research inflation. The number of new grants, the average real size of a grant, and the expected success rate for grant competitions are all expected to fall in 2009.

- **NASA R&D would increase to fund the development and construction of new human spacecraft.** NASA R&D would gain 4.9 percent to $12.8 billion, but the entire increase and more would go to two big projects: finishing the International Space Station and developing the Crew Launch Vehicle and Crew Exploration Vehicle combination (see Table II-12). As a result, NASA support of research in the physical sciences, environmental sciences, aeronautics, and other disciplines would fall once again.

- **Nondefense R&D would increase 3.1 percent to $62.9 billion, compared to the flat funding requested for all nondefense discretionary programs** and well ahead of the 2.0 percent expected inflation rate (see Table II-1). Boosts for the ACI and space vehicles development help to offset requested cuts to earmarks and other smaller nondefense R&D programs, and flat funding for NIH R&D.

- **Most R&D agencies would see increases in 2009, especially if congressional earmarks are excluded** (see Figure 1). While R&D in the U.S. Department of Agriculture (USDA) would decline 1 percent even when $369 million in 2008 R&D earmarks are not counted, and Environmental Protection Agency (EPA) R&D and U.S. Geological Survey (USGS) R&D would fall 0.4 percent and 7 percent, respectively, because of proposed program cuts, most other R&D funding agencies would see gains ahead of expected inflation (see Table II-1). Even DOE's energy R&D programs, coming off extraordinary congressional and requested increases in 2008, would gain another 0.5 percent to reach $2.4 billion and R&D in the Department of Homeland Security (DHS) would rebound from budget troubles in recent years with a 4.1 percent gain to $1.0 billion (see Table 1) that becomes a 13.5 percent boost without 2008 earmarks.

- Defense R&D continues to climb to record levels in wartime, and will be boosted further in both 2008 and 2009 when billions of dollars in war-related supplemental funds are enacted later this year. Total defense R&D would reach $84.5 billion in 2009, up 3.7 percent over FY 2008. Although the total in real terms would be slightly below the record 2007 funding level, both 2008 and 2009 are likely to hit all-time highs after supplementals are enacted. DOD weapons systems development would increase dramatically by $4.5 billion or 6.9 percent to a new high of $69.0 billion, but once again there would be steep cuts in DOD's S&T (DOD "6.1" through "6.3" plus medical research) programs because of the proposed elimination of earmarks. DOD S&T would plummet 11.7 percent to $11.7 billion, but would increase 5.6 percent if 2008 earmarks are excluded. DOD basic research would do especially well with $1.7 billion, a 4 percent increase that becomes a 16 percent increase if earmarks are excluded.

- Multi-agency initiatives on nanotechnology, information technology, and climate change science would all do well in the 2009 budget because of the emphasis on the physical sciences in the ACI and a generally solid R&D budget request. Climate Change Science Program (CCSP) funding would climb above $2 billion for the first time since 2003 with a 9.6 percent or $177 million increase to $2.0 billion (see Table I-9), thanks to environmental sciences programs at NSF and DOE Science benefiting from ACI-inspired increases for these agencies and a restructuring of NASA spending to boost spending on the earth sciences and especially satellite-based observations of climate change. After several rough years, NASA contributions to the CCSP would rebound with a $126 million or 11.7 percent increase to $1.2 billion in 2009. Squarely in the mainstream of the physical sciences, the **Networking and Information Technology R&D** initiative would enjoy a 6.2 percent increase to $3.5 billion because of surging requests for two of its key sponsors, NSF and DOE Science. And the **National Nanotechnology Initiative** would benefit from ACI increases for NSF, DOE Science, and NIST to reach $1.5 billion (up 2.4 percent), partially offsetting steep cuts in DOD's contributions. (For more on the NNI, see Chapter 23; for more on NITRD, see Chapter 22; for more on CCSP, see Chapter 15.) (Details of R&D in the largest R&D funding agencies can be found in Chapters 5 through 12.)

THE ROLE OF R&D IN THE U.S. INNOVATION SYSTEM

Science and technology are recognized as key drivers of economic growth, as well as improved health and quality of life in the United States and throughout the world. Economists estimate that up to half of U.S. economic growth over the past five decades is due to advances in technology. A study of recent U.S. patents released several years ago found that nearly two-thirds of the papers cited in these patents were published by researchers at organizations supported by federal funds—and these linkages have been growing at an accelerating pace.

Recent advances in genetics and biotechnology, as well as computers and information technology, have raised public awareness of the vital economic role of research-based technology. High-tech industry is sought after by economic development organizations in virtually every state and locality. Policymakers regard universities as catalysts for high-tech economic development both through entrepreneurial activity that spins off from their research and through the concentrations of highly trained human resources they attract and generate. The federal government plays a central role in research in the nation's universities.

R&D is a substantial and growing enterprise in the United States. All in all, the U.S. invested an estimated $343 billion in R&D in 2006. This represented 2.60 percent of the nation's Gross Domestic Product (GDP). The largest share of this money (65 percent) came from industrial firms. Most of the balance (28 percent) came from the federal government. Colleges and universities, private foundations, other nonprofit institutions, and state and local governments provided the remainder. Industry's share of national R&D funding has been growing steadily for several decades. From the end of World War II to 1980, the federal government supported the largest share of the nation's R&D.

Despite its relatively modest share of total U.S. R&D funding, the federal government's role is critical to the nation's science and technology enterprise. Federal agencies support the majority (58 percent) of the nation's *basic* research and nearly two-thirds (63 percent) of the R&D performed in U.S. colleges and universities (see Table I-10). Basic research is the primary source of the new knowledge that ultimately drives the innovation process. At the same time, federally funded research at colleges and universities plays a key role in educating the next generation of scientists and engineers. Federal applied research and development programs also provide direct support for key government missions, such as improving the nation's health and medical care, exploring space, and national security.

R&D IN THE FEDERAL BUDGET

Although the President's budget presentation each year generally contains a section devoted to R&D and a number of tables summarizing proposed federal R&D expenditures, it is important to recognize that *there is no overall "R&D budget"* and no special treatment for R&D within the budget.

Expenditures for R&D programs are regular budget items. They are contained, along with other types of expenditures, within the budgets of more than 20 federal departments and independent agencies as shown in Table II-1. For some of those agencies, such as NSF, NASA, and NIH, R&D is a dominant activity. For others, such as the Department of Housing and Urban Development (HUD), it is a small part of a much larger set of programs. Some R&D programs are "line items" in the budget and are relatively easy to identify as R&D. Others are included within larger line items and are more difficult to ferret out.

Federal R&D expenditures represent 4.7 percent of the overall proposed $3.1 trillion federal budget for FY 2009. Nearly all federal R&D comes from the discretionary budget, the one-third of the budget that is subject to annual appropriations decided by the President and the Congress. (The remaining two-thirds of the federal budget goes to mandatory programs (entitlements) such as Social Security, Medicare, Medicaid, and interest on the national debt. Less than 0.2 percent of the federal R&D portfolio is mandatory spending.) Federal R&D is roughly one out of every seven discretionary dollars (see Table I-3). On the whole, trends in R&D funding have closely followed trends in federal discretionary spending. Despite the fact that R&D funding trends are the combination of hundreds of different budget decisions that are only aggregated after a budget is done, the two trends match almost perfectly on the nondefense side for the past 35 years. On the defense side, R&D has grown as a share of the defense budget over the years as high-tech weapons systems have claimed increasing shares of defense spending.

FEDERAL R&D BY PERFORMER

Although the government maintains several hundred laboratories around the country, less than a quarter of federally supported R&D is actually carried out in these labs. The largest share of federally funded R&D is performed by industrial firms under contracts (41 percent of the total; see Figure 2). Less than a quarter is conducted under federal grants in colleges and universities. Other nonprofit institutions perform a small portion, and 9 percent of the portfolio is performed by FFRDCs (federally funded R&D centers) operated by contractors, such as the

Department of Energy's (DOE) Oak Ridge National Laboratory in Tennessee, which is operated in partnership by the University of Tennessee and the Battelle Memorial Institute. Although these figures apply to the overall federal R&D portfolio, each federal funding agency has its own mix of performers depending on the agency's mission and historical relationships with performers. The majority of DOD's R&D portfolio is performed by industry, for example, while DOE sends the majority of its R&D portfolio to its network of FFRDCs; nearly all of the NSF portfolio, however, goes to universities.

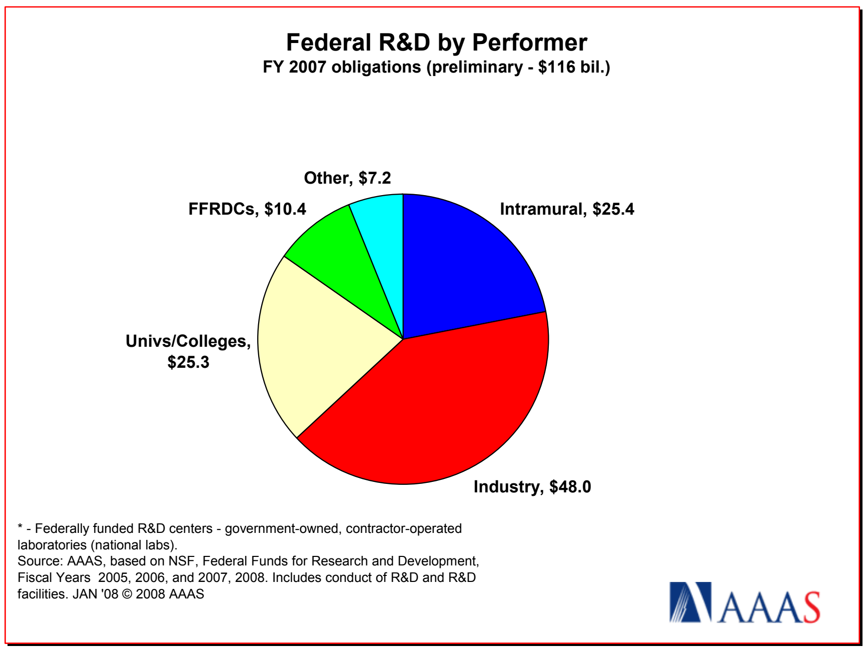

Figure 2.

Altogether, including the research that firms support with their own funds and that which is conducted under government contracts, industry is responsible for performing more than two-thirds (71 percent) of the nation's total R&D. U.S. academic institutions perform 14 percent, while federal laboratories, nonprofit institutions (research institutes, hospitals, etc.), and FFRDCs perform the remainder.

FEDERAL R&D BY NATIONAL MISSIONS

Most of the federal government's R&D is mission oriented; that is, it is intended to serve the goals and objectives of the agency that provides the funds (*e.g.*, agricultural research in the U.S. Department of Agriculture). Only NSF, whose mission is to support basic and applied research, research facilities, and education across a wide range of science and engineering disciplines, has a primary mission to support science and engineering. For the remaining 97 percent of the federal R&D portfolio, R&D investments are the means to achieve other government ends.

The federal government divides the budget into 20 "functional" groupings to illustrate these national missions, each with a function number.[1] The President's budget and the congressional budget resolution divide the total budget "pie" into functional "slices," which serve as non-binding guides for appropriators in allocating funds to agencies and programs. Viewing the R&D budget by function sheds light on the funding priorities assigned to different areas over time, and allows for international comparisons with other nations' spending on R&D by objective. Table I-4 shows R&D by function in the FY 2009 budget.

The Administration priorities of basic physical sciences, space exploration, and defense development show up clearly in the federal R&D portfolio by mission (see Table I-4). The priority missions would all receive large increases, while R&D for most other national missions would gain modestly. Proposed ACI boosts to the DOE Office of Science and NSF make up the 16.9 percent gain for general science R&D to $10.2 billion, while the NIST labs' increase offset partially by NIST extramural cuts would boost commerce R&D by 3.3 percent. Space-related R&D would gain 5.6 percent to $12.3 billion, entirely from gains in development funding of new space vehicles instead of the broader space R&D portfolio. R&D for other national missions including agriculture (down 17.5 percent) and the environment (down 4.3 percent) would fall primarily from the proposed elimination of earmarks. Energy R&D would gain 0.6 percent to $2.5 billion. Funding for health R&D, the largest nondefense mission, would increase slightly by 0.5 percent to $30.8 billion because of flat funding for NIH and Department of

[1] AAAS separates the general science, space, and technology function (function 250) into its subfunctions of General Science (251) and Space (252). AAAS also counts Department of Veterans Affairs R&D programs in the health (550) function instead of veterans affairs (700).

Veterans Affairs (VA) R&D combined with a large increase in biodefense countermeasures R&D in the Department of Health and Human Services (HHS) to $250 million.

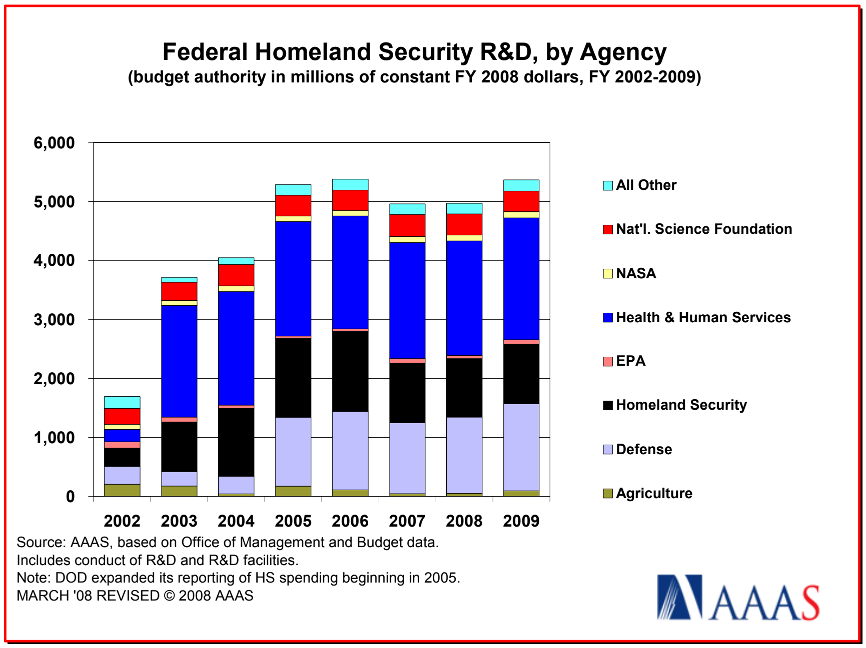

Figure 3.

Although there is much talk of homeland security becoming a major new federal mission, in the budget homeland security spending is a category that cuts across spending on traditional government missions such as national defense, transportation, and justice. R&D in the new Department of Homeland Security (DHS), for example, serves the three missions of administration of justice, general science, and transportation. (See Chapter 11 for more information on DHS.)

Federal homeland security-related R&D would gain 10.2 percent to $5.5 billion in FY 2009, a gain of $507 million reflecting a budget proposal that favors defense spending and homeland security over most domestic priorities (see Table I-6). The majority of the multi-agency portfolio remains outside the Department of Homeland Security (DHS), with the largest part in NIH for its biodefense research portfolio. NIH's portfolio, mostly in the National Institute of Allergy and Infectious Diseases (NIAID), would total $1.9 billion in FY 2008 (up 1.0 percent).

The largest domestic increase would be a $250 million allocation (more than double the $102 million this year) in the Biomedical Advanced Research and Development Authority (BARDA) for R&D on biomedical countermeasures. DOD would continue to increase spending on homeland security-related activities with $1.5 billion, up 16 percent, primarily in Defense Agencies such as the Chemical and Biological Defense Program (CBDP) and the Defense Threat Reduction Agency (DTRA) but with the largest 2009 increase coming from the Air Force. Large increases would also go to food safety research in USDA and decontamination and drinking water protection projects at EPA.

R&D BY CHARACTER OF WORK

The total federal R&D portfolio is made up of five different kinds of investments, known as the "character of work" of R&D. Within the R&D portfolio, distinctions are made among basic research, applied research, development, R&D facilities construction, and capital equipment for R&D (See Appendix 2 for definitions. AAAS tables combine R&D facilities construction and capital equipment for R&D, often described together as "R&D facilities" or "R&D plant.") Basic and applied research together make up "research", while the two research categories plus development make up "conduct of R&D." Adding in R&D facilities construction and capital equipment results in "total R&D" or "R&D."

The figures shown in Tables I-5 and II-1 represent agencies' best attempts to classify basic and applied research, development, and R&D facilities within their R&D portfolios. The data reported here are imprecise and reflect the agencies' judgments as to how their R&D fits into the definitions for character of work.

The **total federal investment in research (basic and applied research) would fall 0.3 percent to $57.3 billion** (see Table II-1). Large proposed increases for the three ACI agencies of NSF, DOE Office of Science, and NIST would be more than offset by steep cuts in other agencies' research.

Once again, development funding would hit a new high of $85.4 billion (up $4.8 billion or 6.0 percent) because of large increases for DOD weapons and NASA spacecraft development. R&D facilities funding would gain 6.2 percent to $4.7 billion (see Table II-1) because of large increases for NASA's International Space Station and DOE Science support on projects such as the International Thermonuclear Experimental Reactor (ITER).

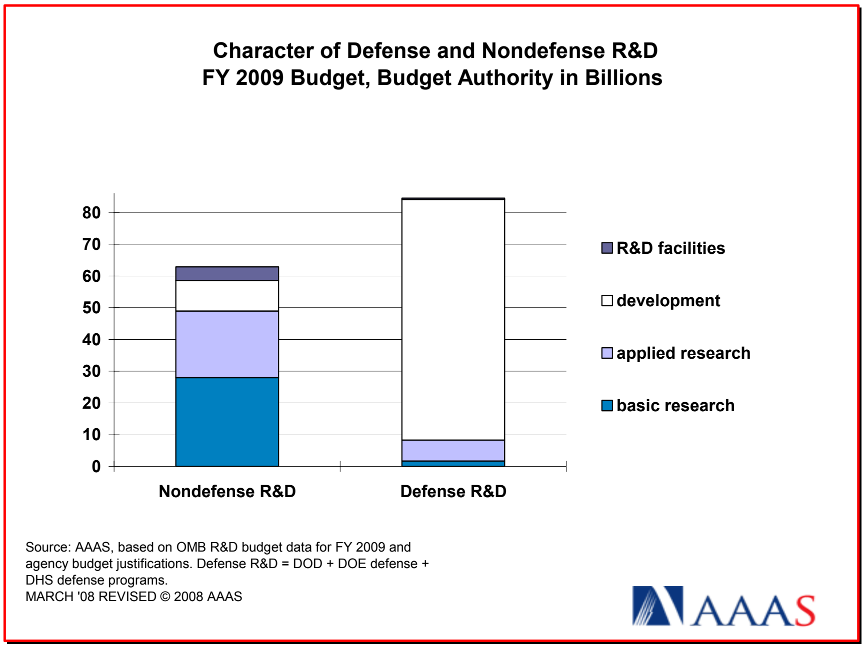

Figure 4.

The character of work is quite different in defense and nondefense R&D, a point illustrated in Table I-5 and Figure 4. Development would be by far the largest component of defense R&D, accounting for 90 percent of the FY 2009 total, while applied research would be 8 percent and basic research would be only 2 percent. In nondefense R&D, by contrast, basic research would be the largest category at 45 percent, with development at only 15 percent and applied research at 33 percent. A major reason for the difference between the character of defense and nondefense R&D is that development in DOD includes testing and evaluation of weapons systems. These activities are extremely expensive compared to other types of R&D. R&D facilities construction and capital equipment costs make up 7 percent of nondefense R&D and 1 percent of defense R&D.

PRIORITY-SETTING FOR FEDERAL R&D INVESTMENTS

Priorities for R&D programs generally depend on the priorities of the agencies in which they are located and the priority of the missions of those agencies. From the standpoint of serving the nation's interests, at least in the short term, this makes good sense, since these R&D programs are not ends in themselves but means to the ends (missions) that their sponsoring agencies serve. From the standpoint of the long-term health of the research enterprise, however, it can cause problems. The mission orientation of R&D programs may make it difficult for policymakers to assess the overall health of the research enterprise, to coordinate programs among different agencies, and to address issues of balance among various scientific and engineering fields and disciplines.

The Office of Management and Budget (OMB), which has overall responsibility for preparation of the President's budget, is able to provide some coordination, although it is hampered by the fact that the agencies that support R&D are treated individually by its different sections in the budget review process. Some coordination also takes place under the National Science and Technology Council (NSTC), an interagency body comprised of cabinet officers and the President. NSTC has organized a number of interagency initiatives in areas of R&D, including global change research, information technology, and nanotechnology. Budgets for three of these initiatives are shown in Table I-9, and are discussed in Chapters 15 (CCSP), 22 (NITRD), and 23 (NNI).

Even the modest level of coordination in R&D in the executive branch is not matched by Congress. Congressional treatment of R&D, like most other aspects of congressional budget and policymaking, is characterized by fragmentation and diffusion of power. R&D programs are considered at two main levels in Congress, that of authorizations and that of appropriations. Authorizing committees (such as the House Science and Technology Committee and the Senate Committee on Health, Education, Labor, and Pensions) develop special expertise in the programs they oversee and review the substance of these programs. However, the legislation they prepare does not directly result in spending but only provides guidance and sets appropriations ceilings.

For discretionary programs, including R&D, the power to write the legislation that provides actual spending authority resides in the Appropriations Committees of the House and Senate. These committees are divided into 12 subcommittees, each of which is responsible for a bill that controls one portion of the budget.

Table I-8 shows the distribution of R&D funds among the appropriations subcommittees; each subcommittee produces its appropriations bill separately from the others, and each bill is usually signed into law separately, although in recent years several bills have had to be bundled into a single omnibus appropriations bill at the end of the congressional session. The FY 2005 omnibus appropriations bill, for example, contained final versions of 9 regular appropriations bills, but in FY 2006 all the appropriations bills were enacted separately. In FY 2008, only one bill (Defense) was enacted individually, and the other 11 bills were rolled into an omnibus bill.

In the congressional appropriations process, the federal R&D investment is contained in 10 of the 12 appropriations bills (see Table I-8). The large proposed increases for NSF, NASA, and NIST will have to find room in the Commerce, Justice, and Science appropriations bill, while DOD development increases would be funded in the Defense bill. The flat NIH budget would be funded in the always-contentious Labor/HHS/Education bill, which contains many health and education programs that are proposed for steep cuts or even elimination in the FY 2009 request.

The division of the budget into 12 appropriations bills limits the extent to which it is possible to coordinate or trade off increases and decreases in agency R&D budgets in the congressional process. For example, three R&D agencies—NSF, NASA, and the Department of Commerce—are under the jurisdiction of the Subcommittee on Commerce, Justice, and Science. NIH appropriations reside in the Labor, Health and Human Services, and Education subcommittee. This means, for example, that money used for the increase in the NASA budget in FY 2005 did not come from the same pot of money as NIH, although NASA's budget increase was offset with a cut in NSF's budget. But this system does mean that R&D programs compete with non-R&D programs in the same appropriations bill for limited funds.

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

Seven years ago, the Office of Management and Budget (OMB) introduced a "Federal Science and Technology" (FS&T) budget in the

FY 2002 budget, and continues to advance this concept in the FY 2009 budget (see Table I-7). The **FS&T budget** is successor to the Clinton Administration's "21st Century Research Fund" (see previous editions of this report) and contains most of the same programs. FS&T is a collection of selected R&D and non-R&D programs that emphasize basic and applied research and the creation of new knowledge or technologies. It also includes some S&T education and training activities but excludes most development, and is designed to be an alternative measure for the federal investment in science and technology and an alternative way to track federal S&T investments in the budget process. (This FS&T budget has a similar emphasis but different definitions from the FS&T concept proposed in 1995 by the National Academies as a subset of federal R&D; thus, the data in Table I-7 differ from NAS discussions of its version of FS&T in previous editions of this report.)

Combined funding for the ACI agencies, a subset of the FS&T budget, would be $12.2 billion in 2009, a dramatic increase of 15.0 percent or $1.6 billion when most other FS&T programs would decline. The cuts in other FS&T programs result in a total FS&T investment that would fall 0.3 percent to $61.8 billion.

U.S. INVESTMENTS IN AN INTERNATIONAL CONTEXT

In absolute terms, the $353 billion spent on R&D from all sources in the U.S. in 2007 was larger than the total R&D expenditures of the entire European Union combined. The U.S. spent 30 percent of world R&D, a share that has declined slightly over the past decade as emerging R&D powers such as South Korea and China have dramatically increased spending (see Figure 5). From tiny amounts in the last decade, China has emerged as a major R&D investor this decade. Adjusting for the much lower costs for R&D talent and equipment there, China is now the second largest R&D performer in the world, having recently overtaken third-place Japan.

When one looks at the national R&D expenditures of various countries in relation to the size of their economies, however, the picture is somewhat different. R&D represented 2.6 percent of gross domestic product (GDP) in the United States in 2004. This places the U.S. below Japan (3.3 percent) but above most other major industrialized countries—including the United Kingdom, France, and Germany. Although the EU recently set a goal of attaining an EU-wide R&D investment ratio of 3 percent of the EU economy by 2010, currently the combined EU nations have a R&D/GDP ratio of just 1.8 percent, down significantly from previous figures because of the induction of 10 less research-intensive nations three years ago. On the other hand, a significant share of the U.S. R&D investment is on the military side, where it has relatively little impact on the civilian economy and U.S. industrial competitiveness. This is very different from the situation in Germany and Japan, which devote only a small portion of their R&D resources to defense. Recently, South Korea surpassed the U.S. in its R&D / GDP ratio, which now stands at 3 percent.

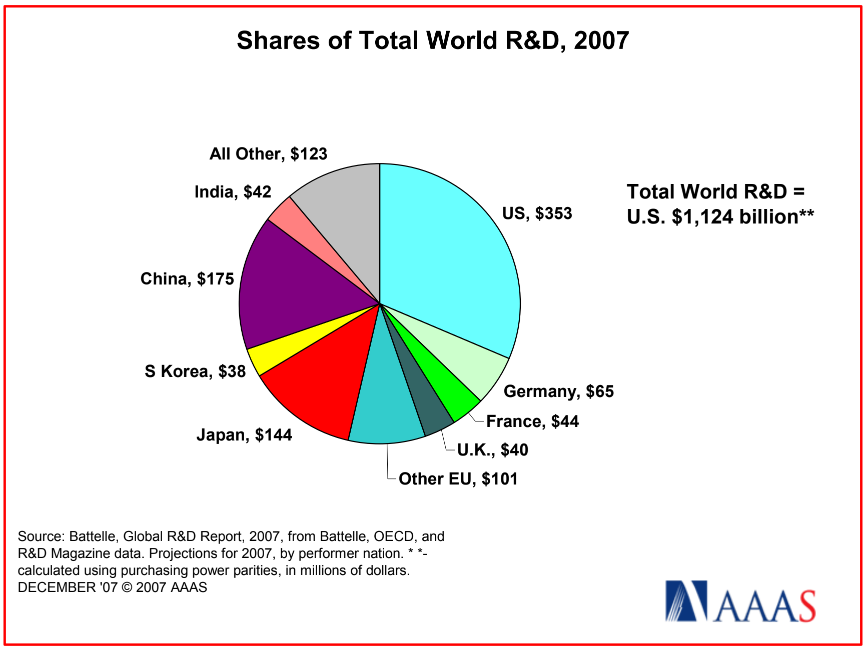

Figure 5.

2

Historical Trends in Federal R&D

Kei Koizumi, AAAS

Although high-priority investments in physical sciences research, weapons development, and human space exploration help to keep the federal R&D outlook brighter than the bleak outlook for domestic programs overall, the FY 2009 budget continues the recent trends of declining federal support for research. (See Table I-11 for historical data. More historical data are available on the AAAS R&D web site.)

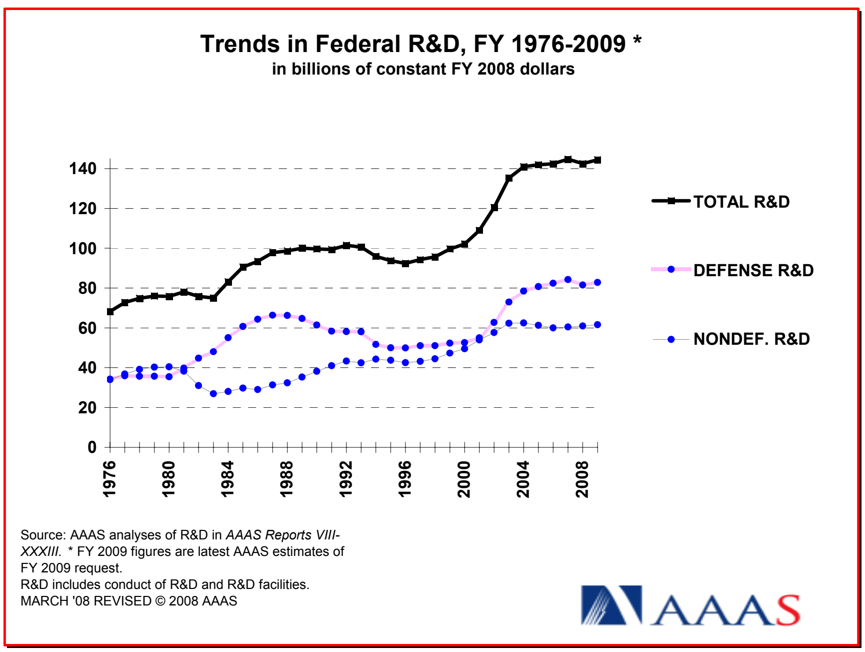

Figure 1.

The total federal R&D request of $147.4 billion, a 3.4 percent increase, would be just ahead of expected inflation (see Figure 1) and would keep the federal R&D portfolio near the record high of FY 2007. Once supplemental appropriations are added, both the FY 2008 and FY 2009 R&D portfolios are likely to exceed the previous record. But the potential gains would go mostly to development funding, and within development mostly for defense weapons.

For defense R&D, nearly all of the increases in the past few years have been in weapons systems development, "6.4" or higher in the Department of Defense (DOD) classification system (see Chapter 5 and Figure 1 in Chapter 5 for details). DOD's S&T investments ("6.1" through "6.3"), comprising basic and applied research and technology development, barely hit a record high in 2005 after taking 16 years to return to Cold War funding levels and have declined since then. But the FY 2009 budget proposes to cut these S&T investments 12 percent, primarily through the proposed elimination of 2008 earmarks. The S&T accounts fund all of DOD's investments in research, including key federal contributions to the support of the physical sciences, engineering, and other research fields. On the development side, large increases for weapons development, especially in the Air Force, and billions of dollars in requested development funding in wartime supplementals have pushed DOD's non-S&T development funding to new highs in recent years.

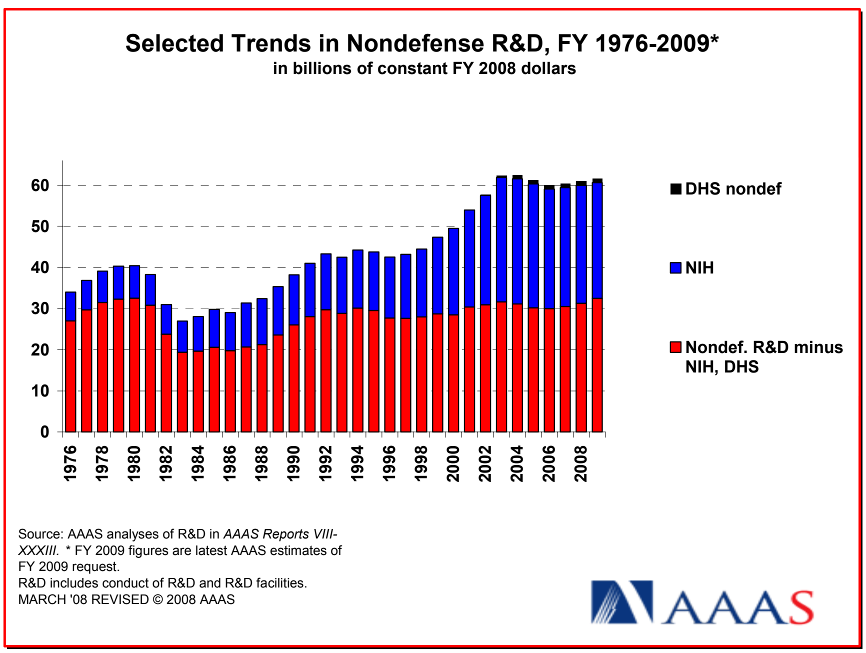

Figure 2.

Nondefense R&D peaked in FY 2004 and then declined, but would increase slightly in the 2009 budget. Nondefense R&D did very well between 1998 and 2003 because of the campaign to double the National Institutes of Health (NIH) budget, as shown in Figure 2. The creation of the Department of Homeland Security (DHS) also helped to boost nondefense R&D investments by creating a new area for investment. But all the other nondefense R&D funding agencies collectively have seen their budgets remain flat for nearly two decades (see the red bars in Figure 2), even as the U.S. economy, the federal budget, and the U.S. population have all boomed during that time. The 2009 proposed increases for the Department of Energy (DOE) Office of Science, the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST) as part of the American Competitiveness Initiative (ACI), plus development gains for the National Aeronautics and Space Administration (NASA) would recover the lost ground of the past few years, and could result in real gains if 2009 appropriations follow the request. These non-NIH agencies, combined with DOD's research investments (also flat or declining in recent years), fund nearly all of the federal investment in non-biomedical research, including the physical sciences, non-medical life sciences, environmental sciences, engineering, mathematics, computer sciences, and social sciences.

The federal investment in basic and applied research would fall in real terms for the fifth year in a row (see Figure 3) if the FY 2009 budget is enacted. Federal research did very well between 1998 and 2003 because of the campaign to double the budget of NIH, the largest federal supporter of research. Other agencies also increased their research investments in that time period because a string of budget surpluses freed up resources for domestic appropriations. But with the return of budget deficits in 2002 followed by restraints on domestic spending thereafter, growth in research funding for NIH and other domestic agencies slowed in 2004 and then reversed. At the same time, DOD research support lagged as the Pentagon went to war in 2003 and shifted resources away from research toward near-term projects, and NASA research fell even within a stable R&D budget as it shifted resources from research to development. Although the ACI agencies would do well in the 2009 budget and would therefore boost their support of research, declining DOD and NASA support of research combined with flat funding for NIH research would more than offset these potential gains.

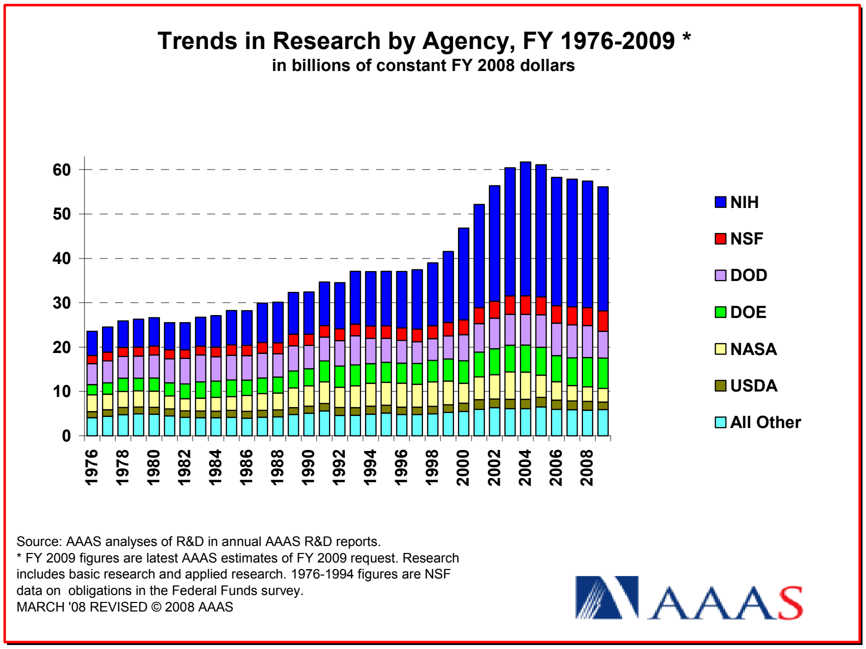

Figure 3.

As a result, federal support for research in nearly all disciplines is now in decline, with potential gains in the physical sciences more than offset by eroding support for biomedical research and other disciplines. The 2009 budget would continue the downward slide in federal research funding and leave the federal research portfolio 9.1 percent below the 2004 level in inflation-adjusted dollars. As shown in Figure 4, flat funding for research in most agencies going back decades has resulted in mostly flat funding for research by science and engineering discipline. Funding for the physical sciences, in particular, has just kept pace with inflation going back three decades, a trend that has prompted the ACI and other attempts to boost federal investments in the physical sciences. Similarly, environmental sciences research and social sciences research have seen stagnant funding for the past decade. Although funding for computer sciences research increased dramatically until 2001 because of the growing importance of computing in all facets of the economy, this funding has stagnated in recent years. The major growth in federal research support has been in biomedical research, particularly during the NIH doubling period 1998-2003, but even this support has declined since the NIH doubling period ended. Meanwhile, federal support for non-biomedical life sciences research has been slipping steadily in recent years. Once agencies' research investments in 2008 and 2009 are spent, the downward trends in these disciplines are almost certain to continue with the possible exception of the physical sciences and engineering.

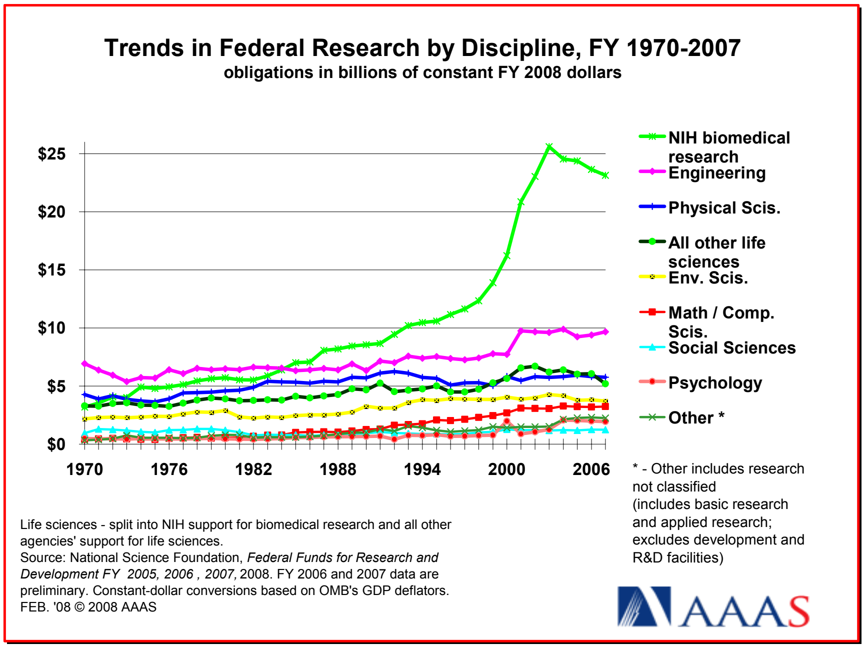

Figure 4.

Federal research investments are shrinking as a share of the U.S. economy, just as other nations are increasing their investments. As shown in Figure 5, the federal R&D investment exceeded 1 percent of U.S. Gross Domestic Product (GDP) until recently, buoyed by big increases in weapons development, but is now declining sharply. Federal investments in development, mostly in DOD, have held steady as a share of the economy, but the federal research/GDP ratio is in free fall down to a projected 0.38 percent in 2009, below the long-term historical average of 0.4 percent after gains in the late 1990s. Despite an increasingly technology-based economy and a growing recognition among policymakers that federal research investments are the seed corn for future technology-based innovations, the U.S. government research investment has so far failed to match the new realities despite the rallying points of innovation and the American Competitiveness Initiative, and has also failed to match the competition. Asian nations are dramatically increasing their government research investments: both China and South Korea, for example, are boosting government research by 10 percent or more annually.

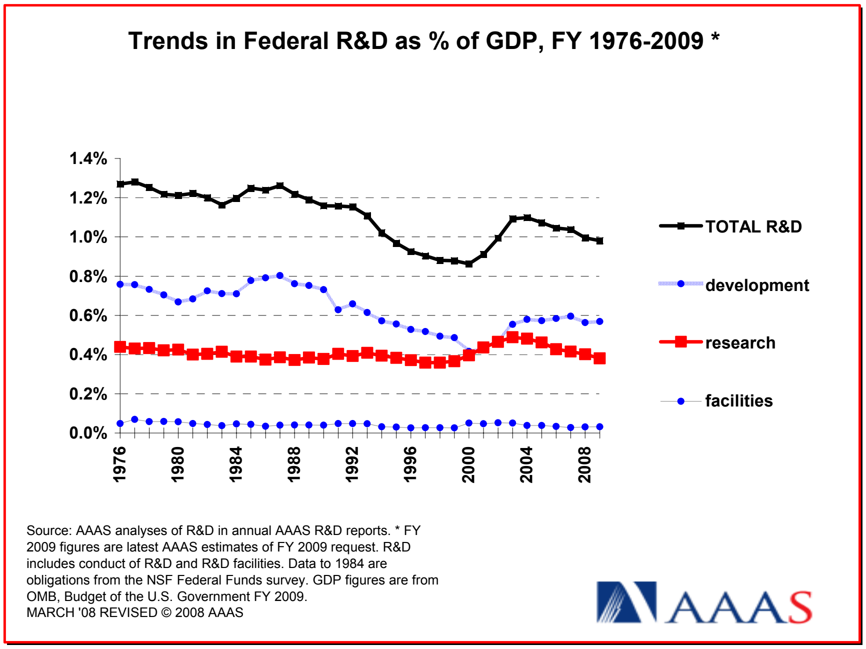

Figure 5.

3

Political and Policy Context for the FY 2009 Budget

Erin Heath and
Lina Karaoglanova, AAAS

R&D IN THE PAST YEAR'S BUDGET PROCESS

Scientists no doubt felt the sting when significant funding increases for agencies related to the American Competitiveness Initiative (ACI) failed to make it into fiscal year (FY) 2008 appropriations at the 11th hour. The ACI, unveiled by President Bush in his 2006 State of the Union address, augured a boon for basic research, as did a slew of innovation bills introduced in Congress. With a new Democratic-led Congress to kick off the process beginning January 2007, observers looked to a fresh start in FY 2008.

Signs were promising in August 2007 when the President signed the America COMPETES Act, the culmination of two years of advocacy work by the scientific, industrial and academic communities sparked by the release of the National Academies' report, *Rising Above the Gathering Storm*. The law authorized spending for a host of research and education programs at the National Science Foundation (NSF), Department of Energy (DOE), National Institute of Standards and Technology (NIST), National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA) and Department of Education.

The party changeover did not speed up the appropriations process, however. Matters were complicated by the President's insistence on vetoing bills that exceeded his budget request. He held to the threat, axing a Labor-Health and Human Services (HHS)-Education bill that would have boosted funding for the National Institutes of Health (NIH).

Throughout much of the year, the situation looked rosy for the "ACI agencies"—NSF, DOE's Office of Science, and NIST—which were looking at significant increases over their FY 2007 budgets. But with little time left before Christmas, Congress was forced to cut its numbers. After feverish negotiations, a final omnibus appropriations bill emerged in mid-December, and the hoped-for ACI increases were not in it. After the ink dried on the President's signature on December 26, NSF, DOE's Office of Science, and the NIST labs were left with much smaller allotments.

Commerce and Homeland Security R&D got solid raises; NASA also got a bump, though the space agency's research component dipped in favor of human space flight programs. NIH funding remained virtually flat. The Department of Defense (DOD), the one agency that saw its own bill signed outside of the omnibus, witnessed a boost for its basic research.

After the FY 2007 moratorium on most domestic earmarks, Congress resumed its earmarking routines for FY 2008. Almost a tenth of the energy R&D budget was devoted to earmarks; earmarks also gave the U.S. Department of Agriculture (USDA) budget a significant buttressing. The overall FY 2008 nondefense R&D earmarks added up to $939 million, down from $1.5 billion in FY 2006.

CONTINUING AND EMERGING R&D POLICY ISSUES

The end result of the FY 2008 appropriations process was a disappointment to those optimistic about major boosts for the ACI agencies. For two years the President's budget has featured the ACI and many members of Congress have voiced support, but the positive intentions have not translated into funding. Scientists have felt the pinch. Programs such as the International Thermonuclear Experimental Reactor (ITER), an international fusion reactor project, lost U.S. funding entirely, and a number of DOE labs were forced to lay off some of their researchers. Nevertheless, innovation, competitiveness, and energy R&D should continue to draw Congress's attention this year. The House and Senate are expected to again seek to increase funding for the physical sciences, especially after the President mentioned this area of research as a top priority in his 2008 State of the Union address.

Congress expects to continue to discuss patent reform, considered a vital issue for competitiveness and innovation, and the No Child Left Behind Act awaits reauthorization. Recently-passed energy legislation authorizes a number of R&D programs in the energy sector.

While these issues should continue to surface, President Bush's last year in the Oval Office and the looming presidential election are likely to put a damper on any significant legislative moves. Though House Speaker Nancy Pelosi (D-CA) is hoping to pass climate change legislation this year, such legislation is unlikely to go forward until after the country elects a new president. The chances of passing legislation addressing controversial issues, including stem cell research, this year are dubious.

Energy security and independence will likely continue to be a large issue for Congress in the coming year, though further action on these issues is unlikely. Both the President's 2008 State of the Union address and the passage of the 2007 energy bill suggest that research into technologies and fuels to reduce America's dependence on foreign oil will remain a high priority for government research. With the passage and enactment of the 2007 energy bill, cellulosic biofuels R&D looks to replace research in corn-derived ethanol, which has proven not to be the silver bullet that many had hoped it would be. Congress is also likely to consider additional carbon capture and storage R&D, as these technologies promise to reduce the greenhouse gas effects of coal-based energy.

Climate change is guaranteed to be a visible issue. Both cap-and-trade and carbon tax bills continued to be introduced in 2007 and into 2008; however, the issue is still very politically divisive and Congress is not likely to push through such a bill in an election year. In general, the issue has gained ground as states have pursued their own regulations, and it is likely to continue to do so. The White House has recently stated that it will seriously consider binding international emission reductions on the condition that large developing nations such as China also agree to reductions.

There is also a positive trend for nanotechnology R&D yet again. Research in the burgeoning industry is steadily gaining ground. The innovative new science is receiving even more attention from Congress and the Environmental Protection Agency (EPA), which has recently established a program to investigate the current nanotechnology landscape for future regulation development.

With the NIH budget moving in a straight line and not set to keep up with inflation, the number of new research grants, the real size of average research grants, and the success rate of grant competitions are all expected to drop this year. The agency has seen a major dip in the success rate of new grant applications, from 32 percent at the start of the decade to a projected low of 18 percent in 2009.

NIH has also sought to revamp its peer review process, which is under strain in the static budget environment. A task force conducted a series of meetings and released recommendations in February 2008. The agency is now exploring the implementation of aspects of the plan. In an effort to recruit and retain young investigators, a top concern for Director Elias Zerhouni, NIH has instituted some targeted grant programs. As a result, the success rate for first-time grant applicants swung upward in FY 2007 after a significant drop over the preceding five years.

In 2007, the President for a second time vetoed the Stem Cell Research Enhancement Act, which would have enhanced federal support for human embryonic stem cell research that follows certain ethical guidelines. He also issued an Executive Order encouraging federal research on stem cells derived by alternative methods.

The issue of government interference and politicization of science has resurfaced for the third consecutive year. Oversight committees in both chambers have taken up investigations of agencies including the EPA, Interior Department, and Food and Drug Administration (FDA). Steps taken by the EPA to close many of the libraries in its nationwide network of libraries that store toxic substances and pollution information sparked serious debate and criticism in 2007. Congress has since intervened with additional monies to keep the libraries from closing their doors.

Investigative committees in Congress have also begun to examine concerns over political appointees in the EPA and the Interior Department allegedly disregarding technical and scientific staff advice. The EPA's rejection of California's request for a waiver that would allow it to regulate its greenhouse gas emissions sparked harsh criticism from many in Congress and from a number of states. Investigations have been launched into the decision, as many are concerned that the politically-appointed EPA administrator may have ignored concerns and recommendations of technical staff within his own agency. The Interior Department's decision to allow oil drilling in prime polar bear habitat before allowing its Fish and Wildlife Service to decide whether it will place the species on the list protected by the Endangered Species Act has earned it similar investigations by Congress.

The FDA has also been dogged by investigations into its food and drug safety practices and by assertions that its budget is inadequate to cover its responsibilities. In September 2007 the President signed a bill to reauthorize key FDA programs; among other things, the bill mandated that drug companies post results of clinical trials in a public database. It is likely that congressional focus on food and drug safety and on the FDA's resources will continue in the coming year.

FORECAST FOR THE FY 2009 BUDGET AND BEYOND

Members of Congress are factoring the President's lame-duck status into their plans for FY 2009. House Appropriations Chairman Dave Obey (D-WI) has stated that if the White House does not show willingness to negotiate on the Labor-HHS-Education bill, he will seek to defer the bill until a new president takes office.

At press time, Sen. Hillary Clinton (D-NY) and Sen. Barack Obama (D-IL) are still in the running for the Democratic nomination, while Sen. John McCain (R-AZ) has clinched the nod on the Republican side. This means that the 44th President will come from the U.S. Senate, which may be beneficial in terms of executive and legislative branch relations. Inevitably, the next administration will usher in different policies and priorities when it comes to R&D and S&T policy. Both Democratic contenders have gone on the record with an interest in maintaining strong support for basic research agencies. It is likely that all three candidates would seek to expand federal funding for stem cell research.

Future climate change research proposals originating in Congress and in the forthcoming presidential election are likely to explore the use of coal in a low-carbon way and include carbon cycle and carbon capture and storage research. Research opportunities in nuclear power may also arise as nuclear is quickly becoming a serious alternative to carbon-intensive fuels. The 2007 energy bill will keep funding prospects for biofuels, especially cellulosic biofuels, wide in the near future.

Whoever becomes the next Commander in Chief, R&D in climate change and energy would undoubtedly undergo increased funding. All three serious presidential candidates have suggested that they will push for global warming reduction legislation and encourage energy efficiency and clean energy.

Table I-1. R&D in the FY 2009 Budget by Agency

Table I-1. R&D in the FY 2009 Budget by Agency
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Percent
TOTAL R&D (Conduct of R&D and R&D Facilities)					
Defense (military)	79,009	77,782	**80,688**	2,906	3.7%
S&T (6.1-6.3 + medical)	*13,518*	*13,215*	***11,669***	*-1,546*	*-11.7%*
All Other DOD R&D	*65,490*	*64,567*	***69,019***	*4,452*	*6.9%*
Health and Human Services	29,621	29,816	**29,973**	157	0.5%
Nat'l Institutes of Health	*28,350*	*28,676*	***28,666***	*-10*	*0.0%*
All Other HHS R&D	*1,271*	*1,140*	***1,307***	*167*	*14.6%*
NASA	11,582	12,188	**12,780**	592	4.9%
Energy	9,035	9,661	**10,519**	858	8.9%
Atomic Energy Defense	*3,649*	*3,718*	***3,825***	*107*	*2.9%*
Office of Science	*3,560*	*3,574*	***4,314***	*740*	*20.7%*
Energy R&D	*1,826*	*2,369*	***2,380***	*11*	*0.5%*
Nat'l Science Foundation	4,440	4,479	**5,175**	696	15.5%
Agriculture	2,275	2,324	**1,955**	-369	-15.9%
Commerce	1,073	1,138	**1,152**	14	1.2%
NOAA	*557*	*581*	***576***	*-5*	*-0.9%*
NIST	*487*	*521*	***546***	*25*	*4.7%*
Interior	647	676	**618**	-59	-8.7%
U.S. Geological Survey	*574*	*586*	***546***	*-41*	*-6.9%*
Transportation	767	820	**902**	81	9.9%
Environ. Protection Agency	557	548	**541**	-7	-1.3%
Veterans Affairs	819	891	**884**	-7	-0.8%
Education	327	321	**324**	3	0.9%
Homeland Security	996	992	**1,033**	41	4.1%
Int'l Assistance Programs	246	255	**255**	0	0.0%
Smithsonian	186	203	**222**	19	9.4%
Tennessee Valley Auth.	20	20	**17**	-3	-15.0%
Labor	24	57	**29**	-28	-49.1%
Nuclear Reg. Comm.	76	71	**77**	6	8.5%
Corps of Engineers	11	11	**11**	0	0.0%
Housing and Urban Dev.	49	51	**55**	4	7.8%
Justice	104	81	**77**	-4	-4.9%
Social Security	27	27	**35**	8	29.6%
Postal Service	43	43	**43**	0	0.0%
Total R&D	141,933	142,456	**147,364**	4,908	3.4%
Defense R&D	82,658	81,500	**84,513**	3,013	3.7%
Nondefense R&D	59,276	60,956	**62,851**	1,895	3.1%

Source: AAAS, based on OMB data for R&D for FY 2009, agency budget justifications, and information from agency budget offices.
Note: The projected inflation rate between FY 2008 and FY 2009 is 2.0 percent.
All figures are rounded to the nearest million. Changes calculated from unrounded figures.

Table I-3. Historical Trends in R&D and Federal Outlays

Table I-3. Historical Trends in R&D and Federal Outlays
(outlays in billions of dollars)

	FY 1970 Actual	FY 1980 Actual	FY 1990 Actual	FY 2000 Actual	**FY 2009 Budget**
Composition of Federal Outlays (Current Dollars)					
Mandatory Programs *	61	262	568	951	**1,636**
Net Interest	14	53	184	223	**260**
Defense Discretionary	82	135	300	295	**671**
Nondefense Discretionary	38	142	201	320	**541**
TOTAL Federal Outlays	196	591	1,253	1,789	**3,107**
Federal R&D Outlays included:					
in Defense Discretionary	8	15	42	42	**79**
in Nondefense Discretionary	8	17	24	37	**66**
TOTAL R&D Outlays	16	32	65	79	**146**
Composition of Federal Outlays					
Mandatory Programs *	31.2%	44.4%	45.3%	53.2%	**52.6%**
Net Interest	7.4%	8.9%	14.7%	12.5%	**8.4%**
Defense Discretionary	41.8%	22.8%	23.9%	16.5%	**21.6%**
Nondefense Discretionary	19.6%	24.0%	16.0%	17.9%	**17.4%**
TOTAL Federal Outlays	100.0%	100.0%	100.0%	100.0%	**100.0%**
Federal R&D Outlays as Percent of Discretionary Outlays [1]					
Defense	10.1%	11.1%	13.9%	14.1%	**11.8%**
Nondefense	19.5%	11.9%	11.8%	11.5%	**12.3%**
TOTAL R&D as % of total discr.	13.1%	11.5%	13.0%	12.8%	**12.0%**
Federal R&D Outlays as Percent of GDP					
Defense R&D	0.8%	0.6%	0.7%	0.4%	**0.5%**
Nondefense R&D [2]	0.7%	0.6%	0.4%	0.4%	**0.4%**
TOTAL R&D	1.6%	1.2%	1.1%	0.8%	**1.0%**

Source: *Budget of the United States Government FY 2009, Historical Tables.*
NA = data not available. * - Net of offsetting receipts.
All figures are rounded to the nearest billion. Changes calculated from unrounded figures.
[1] R&D as a percent of its respective category (*e.g.* , defense R&D as a percentage of defense discretionary).
[2] Includes international and domestic R&D programs.
FY 2009 figures exclude most Iraq and Afghanistan military costs.

Table I-9. Interagency S&T Initiatives

Table I-9. Interagency Science and Technology Initiatives
(budget authority in millions)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Change FY 08-09 Percent
National Nanotechnology Initiative (NNI; see Chapter 23) 2/					
National Science Foundation	389	389	**397**	8	2.1%
Defense 1/	450	487	**431**	-56	-11.5%
Energy	236	251	**311**	60	23.9%
NASA	20	18	**19**	1	5.6%
Commerce (NIST)	88	89	**110**	21	23.6%
HHS - NIH, CDC (NIOSH)	222	232	**232**	0	0.0%
USDA - CSREES, FS	7	11	**8**	-3	-27.3%
EPA	8	10	**15**	5	50.0%
DHS	2	1	**1**	0	0.0%
Justice	2	2	**2**	0	0.0%
DOT - FHWA	1	1	**1**	0	0.0%
Total Nanotechnology	1,425	1,491	**1,527**	36	2.4%
Networking and Information Technology R&D (NITRD; see Chapter 22)					
Commerce	76	85	**90**	5	5.9%
Defense	1,194	1,250	**1,237**	-13	-1.0%
Energy	349	436	**494**	58	13.3%
Environ. Protection Agency	6	6	**6**	0	0.0%
HHS - NIH, AHRQ	566	556	**555**	-1	-0.2%
NASA	79	72	**71**	-1	-1.4%
National Science Foundation	909	931	**1,090**	159	17.1%
All Other	4	5	**5**	0	0.0%
Total IT R&D	3,183	3,341	**3,548**	207	6.2%
Climate Change Science Program 3/ (CCSP; see Chapter 15)					
National Science Foundation	207	205	**221**	16	7.8%
Energy	126	128	**146**	18	14.1%
Commerce (NOAA)	184	240	**260**	20	8.3%
Agriculture	61	65	**62**	-3	-4.6%
Interior	27	34	**31**	-3	-8.8%
Environ. Protection Agency	16	20	**16**	-4	-20.0%
Health and Human Services	47	47	**47**	0	0.0%
NASA 2/	1,084	1,078	**1,204**	126	11.7%
All Other	21	21	**28**	7	33.3%
Total CCSP	1,773	1,838	**2,015**	177	9.6%

Source: OMB supporting data for FY 2009 Budget and budget supplements.
1/ DOD has revised its estimates of its NITRD and NNI contributions.
2/ Beginning with FY 2007, NASA is no longer counting Ground Network and Research Range within CCSP.
3/ Includes U.S. Global Change Research Program and Climate Change Research Initiative.

Table I-10. R&D Expenditures at Colleges and Universities

Table I-10. R&D Expenditures at Colleges and Universities
Fiscal Year 2006

	FY 2005	**FY 2006**	% Change FY 05-06	% of Total (FY 06)
(R&D expenditures in millions of dollars)				
- by funding source:				
Federal Government	29,191	**30,033**	2.9%	62.9%
State and Local Government	2,942	**3,016**	2.5%	6.3%
Industry	2,294	**2,428**	5.8%	5.1%
Institutional Funds	8,258	**9,062**	9.7%	19.0%
All Other Sources	3,093	**3,221**	4.1%	6.7%
Total	45,777	**47,760**	4.3%	100.0%
- by science and engineering field:				
Engineering	6,738	**7,076**	5.0%	14.8%
Physical Sciences	3,704	**3,823**	3.2%	8.0%
Environmental Sciences	2,551	**2,602**	2.0%	5.4%
Mathematical Sciences	495	**530**	7.1%	1.1%
Computer Sciences	1,406	**1,438**	2.3%	3.0%
Life Sciences	27,604	**28,831**	4.4%	60.4%
Psychology	826	**875**	5.9%	1.8%
Social Sciences	1,685	**1,703**	1.1%	3.6%
Other Sciences, n.e.c. *	769	**882**	14.7%	1.8%
Total	45,777	**47,760**	4.3%	100.0%
- by character of work:				
Basic Research	34,348	**36,044**	4.9%	75.5%
Applied Research and Development	11,429	**11,717**	2.5%	24.5%
Total	45,777	**47,760**	4.3%	100.0%

Source: National Science Foundation, *Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2006,* 2007.
The complete data, and definitions of science and engineering fields, are available at http://www.nsf.gov/statistics.
* not elsewhere classified.
These data are based on performer surveys of expenditures, and thus differ from data presented elsewhere in this report.

Table II-1. R&D in the FY 2009 Budget by Agency and Character of Work

Table II-1. R&D in the FY 2009 Budget by Agency and Character of Work
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Change FY 08-09 Percent
TOTAL R&D (Conduct of R&D and R&D Facilities)					
Defense (military)	79,009	77,782	**80,688**	2,906	3.7%
S&T (6.1-6.3 + medical)	*13,518*	*13,215*	***11,669***	*-1,546*	*-11.7%*
All Other DOD R&D	*65,490*	*64,567*	***69,019***	*4,452*	*6.9%*
Health and Human Services	29,621	29,816	**29,973**	157	0.5%
Nat'l Institutes of Health	*28,350*	*28,676*	***28,666***	*-10*	*0.0%*
NASA	11,582	12,188	**12,780**	592	4.9%
Energy	9,035	9,661	**10,519**	858	8.9%
Atomic Energy Defense	*3,649*	*3,718*	***3,825***	*107*	*2.9%*
Office of Science	*3,560*	*3,574*	***4,314***	*740*	*20.7%*
Energy R&D	*1,826*	*2,369*	***2,380***	*11*	*0.5%*
Nat'l Science Foundation	4,440	4,479	**5,175**	696	15.5%
Agriculture	2,275	2,324	**1,955**	-369	-15.9%
Commerce	1,073	1,138	**1,152**	14	1.2%
NOAA	*557*	*581*	***576***	*-5*	*-0.9%*
NIST	*487*	*521*	***546***	*25*	*4.7%*
Interior	647	676	**618**	-59	-8.7%
Transportation	767	820	**902**	81	9.9%
Environ. Protection Agency	557	548	**541**	-7	-1.3%
Veterans Affairs	819	891	**884**	-7	-0.8%
Education	327	321	**324**	3	0.9%
Homeland Security	996	992	**1,033**	41	4.1%
Int'l Assistance Programs	246	255	**255**	0	0.0%
Smithsonian	186	203	**222**	19	9.4%
Tennessee Valley Auth.	20	20	**17**	-3	-15.0%
Labor	24	57	**29**	-28	-49.1%
Nuclear Reg. Comm.	76	71	**77**	6	8.5%
Corps of Engineers	11	11	**11**	0	0.0%
Housing and Urban Dev.	49	51	**55**	4	7.8%
Justice	104	81	**77**	-4	-4.9%
Social Security	27	27	**35**	8	29.6%
Postal Service	43	43	**43**	0	0.0%
Total R&D	141,933	142,456	**147,364**	4,908	3.4%
Defense R&D	82,658	81,500	**84,513**	3,013	3.7%
Nondefense R&D	59,276	60,956	**62,851**	1,895	3.1%

(continued)

Table II-1 (continued). R&D in the FY 2009 Budget by Agency and Character of Work
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Change FY 08-09 Percent
BASIC RESEARCH					
(Please see Chapter 1 for a discussion of these data)					
Defense (military)	1,525	1,634	**1,699**	65	4.0%
Health and Human Services	15,637	15,883	**15,861**	-22	-0.1%
Nat'l Institutes of Health	*15,635*	*15,880*	***15,858***	*-22*	*-0.1%*
NASA	2,318	2,311	**2,287**	-24	-1.0%
Energy	3,134	3,232	**3,557**	325	10.0%
Nat'l Science Foundation	3,626	3,679	**4,320**	641	17.4%
Agriculture	891	868	**798**	-70	-8.1%
Commerce	142	149	**176**	27	18.1%
NOAA	*50*	*55*	***62***	*7*	*12.7%*
NIST	*92*	*94*	***114***	*20*	*21.3%*
Interior	42	43	**40**	-3	-6.5%
Transportation	2	3	**3**	0	0.0%
Environ. Protection Agency	97	95	**95**	-1	-0.7%
Veterans Affairs	335	361	**354**	-7	-1.9%
Education	4	4	**4**	0	0.0%
Homeland Security	221	248	**276**	28	11.3%
Int'l Assistance Programs	18	18	**18**	0	0.0%
Smithsonian	145	149	**153**	4	2.7%
State	0	0	**0**	0	- -
Corps of Engineers	1	1	**1**	0	0.0%
Justice	28	16	**14**	-2	-12.5%
Total BASIC RESEARCH	28,166	28,694	**29,656**	962	3.4%
Defense	1,533	1,641	**1,706**	65	3.9%
Nondefense	26,633	27,053	**27,950**	897	3.3%

(continued)

Table II-1 (continued). R&D in the FY 2009 Budget by Agency and Character of Work
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Change FY 08-09 Percent
APPLIED RESEARCH					
(Please see Chapter 1 for a discussion of these data)					
Defense (military; incl. Med.)	5,783	5,589	**4,439**	-1,150	-20.6%
Health and Human Services	13,813	13,741	**13,911**	170	1.2%
Nat'l Institutes of Health	*12,611*	*12,669*	***12,674***	*5*	*0.0%*
NASA	1,036	963	**816**	-147	-15.3%
Energy	3,014	3,418	**3,448**	30	0.9%
Nat'l Science Foundation	352	339	**422**	83	24.6%
Agriculture	1,072	1,103	**922**	-181	-16.4%
Commerce	629	672	**730**	58	8.6%
NOAA	*339*	*387*	***427***	*40*	*10.3%*
NIST	*278*	*272*	***296***	*24*	*8.8%*
Interior	542	549	**513**	-36	-6.5%
Transportation	563	574	**613**	39	6.8%
Environ. Protection Agency	380	373	**367**	-6	-1.5%
Veterans Affairs	432	474	**478**	4	0.8%
Education	204	201	**199**	-2	-1.0%
Homeland Security	407	381	**378**	-3	-0.8%
Int'l Assistance Programs	188	197	**197**	0	0.0%
Smithsonian	0	0	**0**	0	- -
Tennessee Valley Auth.	6	6	**5**	-1	-16.7%
Labor	4	4	**4**	0	0.0%
Nuclear Reg. Comm.	76	71	**77**	6	8.5%
Corps of Engineers	5	5	**5**	0	0.0%
Housing and Urban Dev.	49	51	**55**	4	7.8%
Justice	17	12	**11**	-1	-8.3%
Social Security	27	27	**35**	8	29.6%
Total APPLIED RESEARCH	28,599	28,751	**27,626**	-1,125	-3.9%
Defense	7,781	7,725	**6,605**	-1,120	-14.5%
Nondefense	20,818	21,025	**21,021**	-4	0.0%

(continued)

Table II-1 (continued). R&D in the FY 2009 Budget by Agency and Character of Work
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Percent
Total RESEARCH (basic + applied)					
(Please see Chapter 1 for a discussion of these data)					
Defense (military; incl. Med.)	7,307	7,223	**6,138**	-1,086	-15.0%
Health and Human Services	29,451	29,624	**29,773**	149	0.5%
Nat'l Institutes of Health	*28,247*	*28,549*	***28,533***	*-16*	*-0.1%*
NASA	3,354	3,274	**3,103**	-171	-5.2%
Energy	6,148	6,650	**7,005**	355	5.3%
Nat'l Science Foundation	3,978	4,017	**4,742**	725	18.0%
Agriculture	1,963	1,971	**1,720**	-251	-12.7%
Commerce	771	821	**906**	85	10.3%
NOAA	*389*	*442*	***489***	*47*	*10.6%*
NIST	*370*	*366*	***410***	*44*	*12.0%*
Interior	584	592	**554**	-38	-6.5%
Transportation	565	577	**616**	39	6.7%
Environ. Protection Agency	476	468	**462**	-6	-1.4%
Veterans Affairs	767	835	**832**	-3	-0.4%
Education	208	205	**203**	-2	-1.0%
Homeland Security	628	629	**654**	25	4.0%
Int'l Assistance Programs	206	215	**215**	0	0.0%
Smithsonian	145	149	**153**	4	2.7%
Tennessee Valley Auth.	6	6	**5**	-1	-16.7%
Labor	4	4	**4**	0	0.0%
Nuclear Reg. Comm.	76	71	**77**	6	8.5%
Corps of Engineers	6	6	**6**	0	0.0%
Housing and Urban Dev.	49	51	**55**	4	7.8%
Justice	45	28	**25**	-3	-10.7%
Social Security	27	27	**35**	8	29.6%
Total RESEARCH	56,764	57,445	**57,282**	-163	-0.3%
Defense	9,313	9,366	**8,311**	-1,056	-11.3%
Nondefense	47,451	48,078	**48,971**	893	1.9%

(continued)

Table II-1 (continued). R&D in the FY 2009 Budget by Agency and Character of Work
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Change FY 08-09 Percent
DEVELOPMENT					
Defense (military)	71,641	70,417	**74,393**	3,976	5.6%
S&T (6.3 Development)	*6,211*	*5,987*	***5,532***	*-455*	*-7.6%*
All Other DOD Develop.	*65,431*	*64,430*	***68,862***	*4,431*	*6.9%*
Health and Human Services	50	50	**50**	0	0.0%
Nat'l Institutes of Health	*0*	*0*	***0***	*0*	*- -*
NASA	6,263	6,470	**7,071**	601	9.3%
Energy	2,091	2,249	**2,458**	209	9.3%
Nat'l Science Foundation	0	0	**0**	0	- -
Agriculture	198	198	**189**	-9	-4.5%
Commerce	84	76	**69**	-7	-9.5%
NOAA	*37*	*36*	***38***	*2*	*5.6%*
NIST	*30*	*17*	***8***	*-9*	*-53.4%*
Interior	55	62	**62**	0	-0.5%
Transportation	183	224	**264**	41	18.1%
Environ. Protection Agency	80	79	**79**	0	-0.6%
Veterans Affairs	52	56	**52**	-4	-7.1%
Education	119	116	**121**	5	4.3%
Homeland Security	368	364	**380**	16	4.5%
Int'l Assistance Programs	40	40	**40**	0	0.0%
Tennessee Valley Auth.	14	14	**12**	-2	-14.3%
Corps of Engineers	5	5	**5**	0	0.0%
Justice	59	53	**52**	-1	-1.9%
Postal Service	43	43	**43**	0	0.0%
State	0	0	**0**	0	- -
Total Development	81,366	80,570	**85,366**	4,796	6.0%
Defense	72,958	71,684	**75,780**	4,096	5.7%
Nondefense	8,408	8,886	**9,586**	700	7.9%

(continued)

Table II-1 (continued). R&D in the FY 2009 Budget by Agency and Character of Work
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Change FY 08-09 Percent
Total CONDUCT OF R&D (basic + applied research, development)					
Defense (military)	78,949	77,640	**80,531**	2,891	3.7%
S&T (6.1-6.3 + medical)	*13,518*	*13,215*	***11,669***	*-1,546*	*-11.7%*
All Other DOD Conduct	*65,430*	*64,425*	***68,862***	*4,437*	*6.9%*
Health and Human Services	29,501	29,674	**29,823**	149	0.5%
Nat'l Institutes of Health	*28,247*	*28,549*	***28,533***	*-16*	*-0.1%*
NASA	9,617	9,745	**10,175**	430	4.4%
Energy	8,239	8,899	**9,463**	564	6.3%
Nat'l Science Foundation	3,978	4,017	**4,742**	725	18.0%
Agriculture	2,161	2,169	**1,909**	-260	-12.0%
Commerce	854	898	**975**	78	8.7%
NOAA	*426*	*478*	***527***	*49*	*10.3%*
NIST	*399*	*384*	***418***	*35*	*9.0%*
Interior	639	654	**616**	-39	-5.9%
Transportation	748	801	**881**	79	9.9%
Environ. Protection Agency	557	548	**541**	-7	-1.3%
Veterans Affairs	819	891	**884**	-7	-0.8%
Education	327	321	**324**	3	0.9%
Homeland Security	996	992	**1,033**	41	4.1%
Int'l Assistance Programs	246	255	**255**	0	0.0%
Smithsonian	145	149	**153**	4	2.7%
Tennessee Valley Auth.	20	20	**17**	-3	-15.0%
Labor	24	57	**29**	-28	-49.1%
Nuclear Reg. Comm.	76	71	**77**	6	8.5%
Corps of Engineers	11	11	**11**	0	0.0%
Housing and Urban Dev.	49	51	**55**	4	7.8%
Justice	104	81	**77**	-4	-4.9%
Social Security	27	27	**35**	8	29.6%
Postal Service	43	43	**43**	0	0.0%
Total Conduct of R&D	138,130	138,015	**142,648**	4,633	3.4%
Defense	82,272	81,050	**84,091**	3,041	3.8%
Nondefense	55,858	56,964	**58,557**	1,592	2.8%

(continued)

Table II-1 (continued). R&D in the FY 2009 Budget by Agency and Character of Work
(budget authority in millions of dollars)

	FY 2007 Actual	FY 2008 Estimate	**FY 2009 Budget**	Change FY 08-09 Amount	Change FY 08-09 Percent
R&D Facilities and Capital Equipment					
Defense (military)	60	142	**157**	15	10.6%
Health and Human Services	120	142	**150**	9	6.0%
Nat'l Institutes of Health	*103*	*127*	***133***	*7*	*5.2%*
NASA	1,964	2,443	**2,605**	162	6.6%
Energy	796	762	**1,056**	294	38.6%
Nat'l Science Foundation	462	461	**433**	-29	-6.2%
Agriculture	114	155	**46**	-109	-70.3%
Commerce	218	241	**177**	-64	-26.6%
NOAA	*131*	*103*	***49***	*-54*	*-52.4%*
NIST	*87*	*138*	***128***	*-10*	*-7.4%*
Interior	8	22	**2**	-20	-90.9%
Transportation	19	19	**21**	2	9.8%
Smithsonian	41	54	**69**	15	27.8%
Total R&D Facils.	3,803	4,442	**4,716**	275	6.2%
Defense	386	450	**422**	-28	-6.2%
Nondefense	3,417	3,992	**4,294**	303	7.6%

Source: AAAS, based on OMB data for R&D for FY 2009, agency budget justifications, and information from agency budget offices.
Note: The projected inflation rate between FY 2008 and FY 2009 is 2.0 percent.
All figures are rounded to the nearest million. Changes calculated from unrounded figures.