8. RESEARCH AND DEVELOPMENT

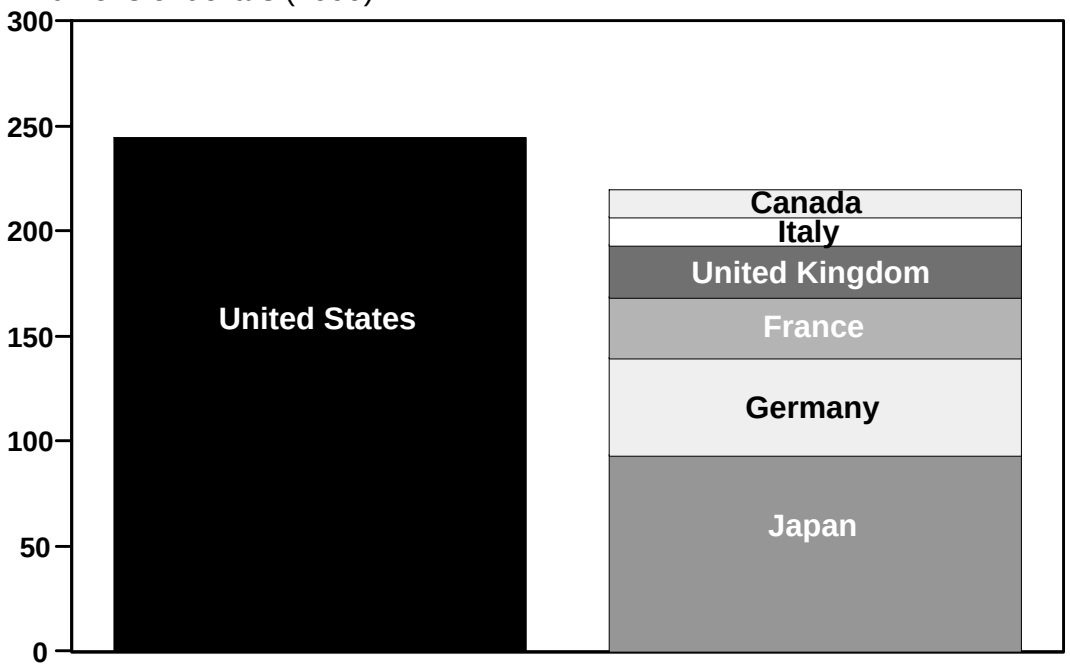
I. INTRODUCTION

Technological innovation and scientific discovery generated much of the Nation's economic growth over the last 50 years, creating millions of jobs, and improving the quality of life. For example, about two-thirds of the 80 percent gain in economic productivity since 1995 can be attributed to information technology. This innovation and discovery was possible because of both public and private investment in research and development (R&D).

The United States' investment in R&D is unparalleled. Our country's investment in R&D plays a major role in the state of the world's science and technology. Not only does the U.S. continue to lead the world in total R&D spending, but, as the most recent data indicate in the accompanying figure, U.S. R&D expenditures—combining private and public—exceed those of the rest of the G–7 countries combined.

The Nation's investments in innovation and discovery are also vital to strengthening our capabilities to combat terrorism and defend our country. The President's 2003 Budget focuses on winning the war against terrorism and securing the homeland, while moderating the growth in overall spending. These priorities have affected the way R&D is being funded and directed, as well as the way the results of R&D are being used. Within the federal government's research portfolio, agencies have been directing many of their programs to assist in the defense effort. For example, one focus of R&D at the Department of Defense (DOD) is to improve detection of biological and chemical threats; the National Institutes of Health (NIH) is financing and conducting research to discover new disease treatments; and the Department of Transportation (DOT) is performing R&D to improve aviation security technology. Investments today in R&D will translate into the new capabilities for tomorrow for detecting threats to our security, defending ourselves against them, and responding to emergencies should they arise.

Chart 8-1. U.S. R&D Expenditures Exceed Those of the Rest of the G-7 Nations Combined



Source: National Science Foundation

If adopted, this budget will provide the highest level of funding for R&D in history, but the focus should not be on how much we are spending, but rather on what we are getting for our investment. Our current priorities also call for redoubling our efforts to meet the President's charge that we improve the management, performance, and results of the federal government. A dedicated effort to improve the overall quality of the total investment in R&D by strengthening effective programs and fixing lower performers through reforms or reallocations will increase the productivity of the federal R&D portfolio and transcend the all-too-common attention given to year-to-year marginal increases or decreases. Additionally, while it can be difficult to assess the outcomes of some research programs—many of which may not have a measurable effect for decades—it is important to establish meaningful goals for them and to measure annual progress toward them and performance in appropriate ways. Towards that end, the Administration is developing investment criteria for R&D programs across the government. Finally, the government must coordinate interrelated and complementary R&D efforts among agencies, combining programs where appropriate to improve effectiveness and eliminating redundant programs, to leverage these resources to the greatest effect.

The federal government has multiple roles in achieving these goals. The government should be strong in its support of basic research, as it is the source of tomorrow's discoveries and new capabilities, and it will fuel further gains in economic productivity, quality of life, and national security. The government should also support those areas of applied research and development critical to the missions of the federal agencies, particularly in priority areas that private sources are not motivated to support. If the private sector cannot profit from the development of a particular technology, federal funding may be appropriate if the technology in question addresses a National priority or otherwise provides societal benefits. Finally, the federal government should help stimulate private investment and provide the proper incentives for private sources to continue to fuel the discovery and innovation of tomorrow. The Administration plans to do this through the permanent extension of the Research and Experimentation tax credit.

To these ends, this chapter discusses how the Administration will improve the performance of R&D programs through new investment principles and other means that encourage and reinforce quality research. The chapter also highlights the priority areas proposed for R&D agencies and the coordinated efforts among them. The chapter concludes with details of R&D funding data across the federal government.

II. IMPROVING PERFORMANCE OF R&D PROGRAMS

R&D is critically important for keeping our Nation economically competitive. It will help solve the challenges we face in health, defense, energy, and the environment. As a result, and consistent with the Government Performance and Results Act, every federal R&D dollar must be invested as effectively as possible.

R&D Investment Principles

The Administration is improving the effectiveness of the federal government's investments in R&D by subjecting investment decisions to transparent investment criteria. R&D requires special consideration in the context of performance assessment, as many R&D outcomes—especially those of basic research—may not be obvious for years or decades. Nevertheless, the government must improve its basis for deciding among R&D investments, including applying specific criteria that projects must meet and clear milestones for measuring performance.

The Department of Energy (DOE) R&D Performance Pilot: As announced in the President's Management Agenda, the Administration developed investment criteria using DOE's applied energy R&D programs as a pilot. These are the Fossil Energy, Nuclear Science and Technology, and Energy Efficiency and Renewable Energy programs. The Administration is using the R&D criteria to recommend funding levels for the Department's applied R&D programs that support the President's National Energy Policy report.

In the first year of the pilot project, application of the criteria indicated that data on the expected performance of many R&D projects are not readily available. For instance, using one energy-based metric, some of 19 Fossil Energy R&D programs failed to report any performance data at all, and those that did tended to report goals rather than the current cost performance of technologies under development. The Department, in conjunction with the Office of Management and Budget, is working to improve these performance metrics and data. DOE will improve the grading method to distinguish among programs more effectively. In this first year, about 80 percent of the criteria graded by DOE achieved a maximum score.

Despite these initial problems, the criteria provided enough guidance to determine some opportunities for redirecting funds. In the fossil energy program, research to control greenhouse gases was increased, since there is little incentive for private investment in this area. Conversely, areas such as oil drilling technology, where the industry has the financing and incentive to do its own research, are funded at lower levels. Within DOE's renewable energy portfolio, wind power research will shift focus from technologies for high wind-speed areas to cost-effective technologies for low wind-speed areas, which are further from commercial viability and show great promise for greatly expanding the land area that can be used to capture this renewable energy resource. DOE will continue to work to integrate the R&D criteria more meaningfully into their budget formulation process in the coming year.

Based on lessons learned from the DOE pilot project and other inputs from experts and stakeholders, the Administration will develop R&D investment criteria to assist with budget allocation decisions at major R&D agencies starting in the 2004 budget process. While the specific criteria to be used in 2004 are still under development, several fundamental principles motivate and will guide them, including:

- Federal R&D priorities should be consistent with priorities identified by the President.
- Federal R&D programs should focus on activities that require a federal presence to attain national goals. To avoid public funds displacing private investment, federally funded R&D should focus primarily on areas where the private sector cannot capture the benefits of the R&D.
- Programs and proposals should have thorough plans for the research, with clear goals and planned end points or off-ramps, when appropriate.
- To maximize the quality of the research process and the efficiency of the public investment, research programs should use a competitive, merit-based process where appropriate. Exceptions must be well justified.
- Agencies and programs judged to be outstanding in conducting, awarding, and managing R&D should be identified and supported.
- Less successful programs should follow successful models to achieve improvements, or they should be reduced or moved to agencies where they can be managed more effectively.
- Resources for new R&D priorities will be increased by reducing or eliminating the funding for programs that have completed their mission or that are redundant or obsolete.

The Administration recognizes that researcher time is best spent on research and that added administrative burden for researchers is counterproductive. During the development and implementation of the investment criteria, the Administration will take the necessary steps to minimize their administrative burden and maximize their utility.

The Administration has been studying management strategies for R&D that some agencies use to promote particularly effective programs. OMB and the Office of Science and Technology Policy (OSTP) are developing a common analytical framework to assess the strengths and weaknesses of R&D programs across agencies, in order to identify and apply good R&D management practices across the government. For example, some agencies have more deliberate prioritization process, while other agencies have more experience estimating the returns of R&D and assessing the impact after the fact. The process of developing this framework will be iterative, involving the research agencies and the science and technology community.

Due to the distinct goals and methods of basic research versus applied research and development, separate criteria are being developed. The Office of Science and Technology Policy (OSTP), OMB, and the federal agencies will work with the science and technology community to define helpful criteria and implement them effectively in preparation of the 2004 budget.

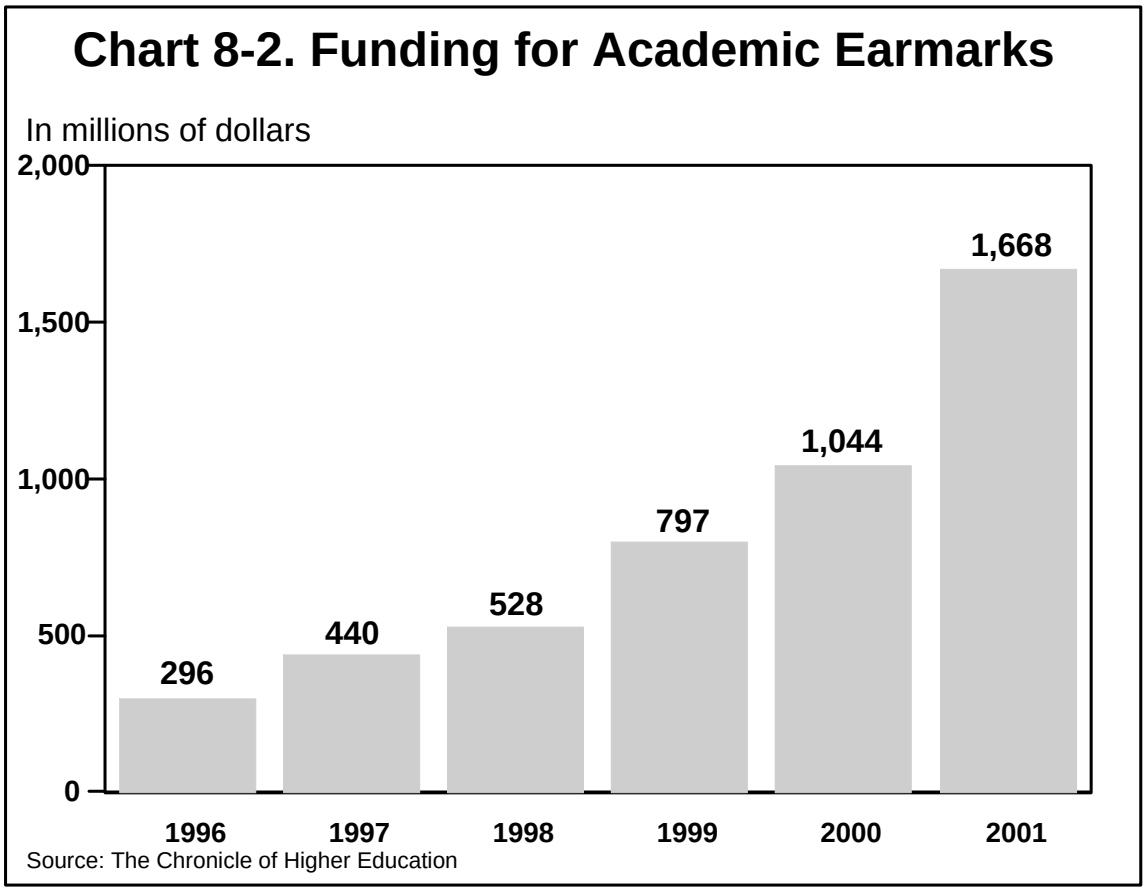
Using some of the principles identified above, the President's Budget begins to improve the performance of research programs across the government.

As an example of improving a program, the Administration is reforming the Department of Education's Office of Educational Research and Improvement (OERI) by implementing a more rigorous grant solicitation and peer review process. The Department is also developing a reauthorization proposal for OERI that should allow it to improve the quality, objectivity, coordination, and focus of the Department's research activities.

The budget transfers some R&D programs between agencies. For example, the transfer of the U.S. Geological Survey's Toxic Substances Hydrology program and the National Oceanic and Atmospheric Administration's Sea Grant program to NSF's more competitive, peer-review award process will improve the scientific rigor of the research. The peer review process allows the assessment of merit by other experts in the field, while competition ensures that the grants ultimately awarded have demonstrated their merit, over other competitive proposals.

Research Earmarks

The Administration supports awarding research funds based on merit review through a competitive process. Such a system ensures that the best research is supported. Research earmarks—in general the assignment of money during the appropriation process for use only by a specific organization or project—are counter to the competitive process of selection based on merit. The use of earmarks improperly signals to potential investigators that there is an alternative to creating quality research proposals for merit-based consideration, including the use of political influence or by appealing to parochial interests.



Moreover, the practice of earmarking funds directly to colleges and universities for specific research projects has expanded dramatically in recent years. Despite broad-based support for merit review, earmarks for specific projects at colleges and universities have yet again broken prior records. According to *The Chronicle of Higher Education,* academic earmarks have steadily increased from a level of $296 million in 1996 to an estimated $1.67 billion in 2001. In 2001 alone, earmarked funds to colleges and universities increased nearly 60 percent (see figure). These funds represent an increasing share of the total federal funding to colleges and universities, which increasingly displaces competitive research, awarded by merit. For example, in 1996, academic earmarks accounted for 2.5 percent of all federal funding to colleges and universities. By 2001, the earmarked share of federal academic funding had increased to a high of 9.4 percent. While comparable figures for 2002 are not yet available, the assessment of research allocation in Table 8–5 at the

end of this chapter suggests that this trend has continued to grow for non-defense agencies in 2002.

Some argue that earmarks help spread the research money to the states that would receive less research funding through other means. However, *The Chronicle of Higher Education* reports that this is not the main role they play. In 1999, for example, only a small share of academic earmark funding went to the states with the smallest shares of federal research funds. In fact, the 25 states with the largest shares of federal research dollars also received 74 percent of the earmark funding to colleges and universities. Meanwhile, earmarks help some rich institutions become richer. In 1999, 13 of the 25 institutions receiving the most earmarks were also members of the top 100 for total research funds. Table 8–7 provides a list of the 30 colleges and universities that received the most earmarked funding in 2001, according to *The Chronicle of Higher Education* (results for 2002 are not available at this time).

There is a tendency to confuse a high budget number appropriated for an agency with a good outcome for the agency, but this is often not the case. Often, earmarks drive these increases. Worse yet, the flood of earmarks within that level displaces important competitive programs that have to be deferred or terminated. For example, in 2002 appropriations, earmarked funding for constructing a low priority propulsion lab at the National Aeronautics and Space Administration (NASA) was paid for by cutting the very research that the lab is to support.

Earmarks for research facilities can come at the cost of operations or research at those facilities. For example, earmarks in DOE's Office of Science increased 60 percent from 2001 to 2002. As a result, DOE has only the resources to operate its scientific user facilities at approximately 75 percent of the optimally available hours. Had these funds been allocated to facility operations as needed, a broader segment of the research community could have benefited, and the return on the federal investment in these facilities would have been higher.

Some proponents of earmarking assert that earmarks provide a means of funding unique projects that would not be recognized by the conventional peer-review process. On the contrary, a number of agencies have procedures and programs to reward out-of-the-box thinking in the research they award. For example, DOD's Defense Advanced Research Projects Agency seeks out high risk, high payoff scientific proposals, and NSF program managers set aside a share of funding for higher-risk projects in which they see high potential.

Many earmarks have little to do with an agency's mission. For example, Congress earmarked DOD's 2002 budget to fund research on a wide range of diseases, including breast cancer, ovarian cancer, prostate cancer, diabetes, and osteoporosis. Funding at DOD for such research totals over $600 million in that year alone. While research on these diseases is very important, it is not unique to the U.S. military and can be carried out and coordinated better within civil medical research agencies, without disruption to the military mission.

The Administration is working with the scientific community to discourage the practice of research earmarks. Academic organizations, such as the Association of American Universities, and colleges and universities, including Massachusetts Institute of Technology and Washington University in St. Louis, have stated that they share the Administration's preference for merit review and recognize the problems with academic earmarks. The Administration will continue to work with such organizations and universities and the Congress to achieve our common objectives.

III. PRIORITIES FOR FEDERAL RESEARCH AND DEVELOPMENT

The 2003 budget requests record levels for federal R&D ($111.8 billion, an 8 percent increase, as shown in Table 8–2). The Administration recognizes that investments in research—especially in basic research—will lead to the discoveries and technologies of tomorrow. The 2003 budget includes an emphasis on basic research, increasing associated funding across the agencies by $2.0 billion (or 9 percent).

In a 1995 report from the National Academy of Sciences, the scientific community proposed a "Federal Science and Technology" (FS&T) budget. Such a compilation highlights activities central to the creation of new knowledge and technologies more consistently and accurately than the traditional R&D data collection reported in Table 8–2. As shown in Table 8–3, the 2003 budget requests $57.0 billion for FS&T (a 9 percent increase). The resulting FS&T budget is less than half of the total federal spending on R&D, though FS&T also includes some funding that is not R&D. Discussions of agency efforts in this section include the FS&T values from Table 8–3.

Some in the science community call for greater "balance" across research agencies and disciplines, at times suggesting that all agencies should receive increases similar to those that NIH and other agencies have received. However, "balance" by that definition makes prioritization impossible. Increases in our top-priority research areas should logically be greater than increases for other areas. Instead, the 2003 budget provides funding for top priority areas, while ensuring a good mix of basic, applied, and development in many fields of science and technology across the federal agencies. The Administration believes the focus should not be on how much we are spending, but rather on what we are getting for our investment and how well it is being managed.

Over the past year, OSTP and OMB have worked with the federal agencies and the science community to identify top priorities for federal R&D. Some are in areas critical to the Nation, such as information technologies. Some are in emerging fields, such as nanotechnology, that will provide new breakthroughs

across many fields. Others, such as anti-terrorism R&D, address newly recognized needs. The discussion below identifies four multi-agency priority areas, followed by highlights of agency-specific R&D priorities.

Multi-Agency R&D Priorities

The 2003 budget targets investments in important research that benefits from improved coordination across multiple agencies. Two of these multi-agency initiatives—nanotechnology and information technology R&D—have separate coordination offices under the auspices of NSF to ensure coordinated strategic planning and implementation. Both initiatives will be producing integrated plans to describe detailed research proposals for 2003. The Administration is in the process of forming new organizations and strengthening interagency coordination for two priority areas—anti-terrorism and climate change R&D. The Administration will continue to consider other areas of critical need that could benefit in the future from improved focus and coordination among agencies.

Anti-terrorism R&D: Scientific and technological advances will be used to prevent and respond to possible future terrorist activities at home and abroad. Potential antiterrorism R&D applications span a wide range, including safeguarding the mail, developing new vaccines and air safety systems, and creating advanced materials and enhanced building designs. Most aspects of our national life are being assessed for vulnerabilities to terrorists. Often, the scientific and technological community will be asked to devise solutions in cost-effective ways that do not impinge on our way of life. Over the next six months, OMB, OSTP, and the Office of Homeland Security will be working through the National Science and Technology Council (NSTC) to develop a coordinated, interagency R&D plan for antiterrorism. This budget identifies many antiterrorism R&D priorities (such as rapid detection and verification of biological threats). The NSTC plan will chart a comprehensive and integrated course for these efforts as well as provide cross-agency budgetary information.

Networking and Information Technology R&D: The budget provides $1.9 billion (a 3 percent increase) for the multi-agency Networking and Information Technology Research and Development Program (NITRD). By coordinating key advanced information technology research efforts, the NITRD agencies leverage resources to make broader advances in computing and networking than a single agency could attain. For example, the NITRD agencies develop and deploy computing platforms and software that perform over a trillion computing operations per second, to support advanced federal research in the biomedical sciences, earth and space sciences, physics, materials science and engineering, and related scientific fields. Accomplishments include: development of end-to-end optical fiber networking, providing vast improvements in bandwidth and network security for research and commercial applications; new technologies enabling cluster, or "grid," computing, providing for the first time access to high-performance computation for scientific researchers nationwide; technologies for network security protection such as intrusion detection and risk and vulnerability analyses; and technologies for archiving, managing, and using large-scale information repositories, or "digital libraries." In 2003, research emphasizes include network "trust" (security, reliability, and privacy); high-assurance software and systems; micro- and embedded sensor technologies; revolutionary architectures to reduce the cost, size, and power requirements of high end computing platforms; and social and economic impacts of information technology.

Nanotechnology R&D: The budget provides $679 million for the multi-agency National Nanotechnology Initiative, a 17 percent increase over 2002. The initiative focuses on long-term research on the manipulation of matter down to the atomic and molecular levels, giving us unprecedented building blocks for new classes of devices as small as molecules and machines as small as human cells. This research could lead to continued improvement in electronics for information technology; higher-performance, lower-maintenance materials for defense, transportation, space, and environmental applications; and accelerated biotechnical applications in medicine, healthcare, and agriculture. In 2003, the initiative will focus on fundamental nanoscale research through investments in investigator-led activities, centers and networks of excellence, as well as the supporting infrastructure. Priority areas include: research to enable efficient nanoscale manufacturing; innovative nanotechnology solutions for detection of and protection from biological-chemical-radiological-explosive agents; the education and training of a new generation or workers for future industries; and partnerships and other policies to enhance industrial participation in the nanotechnology revolution. The convergence of nanotechnology with information technology, modern biology and social sciences will reinvigorate discoveries and innovation in many areas of the economy.

Climate Change R&D: In June 2001, the President announced that the Administration's climate change policy will be science-based, and it will encourage research breakthroughs that lead to technological innovation. To advance and bring focus to climate change science and technology, the President created two new initiatives: the Climate Change Research Initiative (CCRI) and the National Climate Change Technology Initiative (NCCTI). The Administration committed to funding high-priority areas where investments can make a difference. These new initiatives will complement ongoing research funded under the U.S. Global Change Research Program (USGCRP) and other related technology research programs that address climate change.

The USGCRP has existed for more than a decade, and provides funding at nine different agencies for fundamental research on natural and human-induced

changes in the global environment, with the goal of attaining a more complete understanding of global climate change to better respond to the challenges it presents. In 2003, this program will continue, with a total funding level of $1.7 billion, an increase of 3 percent over the 2002 enacted level. The 2003 budget will pause the development of follow-on NASA satellites, the largest single item in the USGCRP budget, consuming more than half of total program funding. NASA will not start new satellites until a review of the USGCRP, and its relationship to the new CCRI, is complete.

In addition to increasing funding for USGCRP, the budget requests $40 million in CCRI, to be shared among five agencies (NOAA, NSF, NASA, DOE, and USDA). This investment will begin to focus on answering key gaps in knowledge among those recently identified by the National Academy of Sciences in a report from 2001: "Climate Change Science: An Analysis of Some Key Questions." This includes improving the capability of "integrating scientific knowledge, including its uncertainty, into effective decision support systems." CCRI will adopt performance metrics and deliverable products useful to policymakers in a short time frame (2–5 years).

The NCCTI will build on an existing base of research and development in climate change technologies, primarily at DOE, EPA, and USDA. The budget requests $40 million for NCCTI within the DOE budget. Specific research areas are being identified through an interagency review process.

Agency R&D Highlights

Each federal agency conducts R&D in the context of that agency's unique mission, structure, and statutory requirements. Below are highlights of key R&D programs in selected agencies in the 2003 budget. Table 8–3 shows the FS&T budget. As shown in Table 8–2, these programs and those of other agencies are part of the larger federal R&D portfolio.

National Institutes of Health: NIH comprises 25 Institutes and Centers whose collective mission is to sponsor and conduct biomedical research and research training that leads to better health for all Americans. While NIH does conduct research in its own laboratories, a majority of its funding supports more than 50,000 scientists working in 2,000 institutions across the United States. With the help of NIH grants, these scientists have been making great advances in the detection and treatment of diseases. All NIH grants are peer-reviewed and are funded based on their scientific merit.

During the presidential campaign, the President promised to double the budget of the NIH by 2003 to $27.3 billion, from the 1998 level of $13.6 billion. The 2003 budget includes the final installment of $3.9 billion needed to fulfill the President's commitment, which will maximize the opportunity to expand scientific discovery by increasing the number of new research grants funded. With this increase, NIH will further its efforts to support research on diseases that affect the lives of all Americans. For example, the budget provides $5.5 billion for cancer-related research at the National Cancer Institute and other NIH Institutes.

This NIH funding increase will also finance important research needed for the war against terrorism. As the country faces new and dangerous bioterrorism threats, the NIH will expand research on the effects of bioterrorism attacks and develop treatments in the event our Nation is ever attacked. The 2003 budget provides $1.75 billion for bioterrorism research, including genomic sequencing of dangerous pathogens, development of improved anthrax vaccine, and laboratory and research facilities construction and upgrades related to bioterrorism and Z-chip technology research. With the ability to identify a vast number of molecular signatures, the Z-chip can be used on the front line of medical response for nearly instant diagnosis of a wide array of biothreats or naturally occurring diseases, saving precious time and therefore lives in the first hours of a biological attack.

National Aeronautics and Space Administration: The 2003 budget provides $8.8 billion for FS&T programs at NASA, an 8 percent increase over 2002. The 2003 budget restructures under-performing programs and provides funding to address key issues including establishing a long-term strategy for planetary exploration, emphasizing near-term results in climate change research, prioritizing research on the International Space Station, lowering the cost of access to space, and improving the safety and efficiency of the Nation's civil aviation system.

In Space Science, the 2003 budget of $3.4 billion discontinues NASA's Outer Planets program due to substantial cost and schedule growth and redirects funding to a revamped New Frontiers program of competitively selected planetary missions focused on understanding the origins and existence of life beyond Earth. The 2003 budget also supports investments in safe and reliable nuclear power and nuclear-electric propulsion technologies to enable much faster and more frequent planetary investigations with greater science capabilities in this decade and the next. The 2003 budget for Earth Science ($1.6 billion) supports two important demonstrations—the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project and the Jason follow-on—which will measure key variables that are needed to provide long-term, climate quality data to understand how the Earth's climate is changing. In Biological and Physical Research, the 2003 budget of $851 million will yield clear priorities for Space Station research and invests in space radiation and space biology research initiatives that will enable new space platforms through which biological and physical research can be pursued.

The 2003 budget continues planned increases in funding for NASA's Space Launch Initiative ($759 million in 2003), a high priority program that will lead to safer and lower cost, commercial launch vehicles to replace the Space Shuttle. The 2003 budget maintains key in-

vestments in technologies to improve aircraft safety and to reduce congestion in the Nation's civil aviation system ($220 million).

National Science Foundation: The 2003 budget provides $5.0 billion, a 5 percent increase, for research at NSF, whose broad mission is to promote science and engineering research and education. The budget provides: $678 million for NSF's lead role in NITRD, focusing on long-term computer science research and applications; $221 million for NSF's lead role in the National Nanotechnology Initiative; $15 million for NSF participation in the Climate Change Research Initiative—in addition to $188 million for USGCRP—for research on climate change risk management, understanding the North American carbon cycle, and computer modeling; $27 million (a $20 million increase) for NSF basic research programs in microbe genome sequencing and the transmission of infectious diseases, two research areas of importance in combating bioterrorism.

Based on NSF's noted expertise and success in funding competitive research, the 2003 budget aims to improve the quality of a number of science and engineering programs by transferring them to NSF. The budget transfers the National Oceanic and Atmospheric Administration's Sea Grant program and the United States Geological Survey's toxic substances hydrology research program to NSF, where merit-based competition will improve overall program effectiveness. These transfers will take advantage of NSF's competitive culture and demonstrated quality of results.

The President's goal to improve the quality of math and science education in Grades K–12 will be pursued through the President's Math and Science Partnerships Initiative, which allows states to join with institutions of higher education, particularly math and science departments, in strengthening math and science education. The initiative provides a mechanism to allow scientists and engineers to be part of the solution in improving grades K–12 education. Funding for the programs is proposed to increase by $40 million, to $200 million. The budget also aims to further attract the most promising U.S. students into graduate level science and engineering by increasing graduate stipends from $21,500 to $25,000 annually.

Department of Energy: The 2003 budget provides $5.0 billion for FS&T at DOE. The budget proposes $3.3 billion, a 1.5-percent increase over 2002, for DOE Science programs, the Nation's leading sponsor of research in the physical sciences. DOE has a special role in supporting research in particle physics, nuclear physics, fusion energy sciences, chemistry of the radioactive elements, nanoscience, genomic sequencing, and computational science. The Department also supports research that will reduce key scientific uncertainties inherent in climate change and carbon cycle models. These basic science programs support the DOE's applied missions in energy, national nuclear security and environmental quality. The Department contributes to national science stewardship, a cornerstone of the Department's mission, by operating a suite of 27 scientific user facilities—such as x-ray light sources, fusion experiments, particle accelerators and colliders. Over 18,000 scientists from universities, industry and government agencies use these facilities every year. Consistent with the Administration's emphasis on shifting funds to higher priority programs, the budget redirects funding to maintain operations at Fermi National Accelerator Laboratory.

The Department sponsors applied research and development programs with two primary interests. In the national security area, DOE sponsors R&D that sustains the safety, reliability, and performance of the Nation's nuclear weapons ($3.1 billion in 2003). Nonproliferation and verification research conducted by the Department advances technologies for detection of nuclear weapons proliferation, nuclear explosion monitoring, and chemical and biological response. In the energy area, DOE sponsors research in energy production and use, from fossil, nuclear, and renewable sources. The Department has had success in reducing the cost of renewable energy resources (wind, solar, geothermal, and biomass), and it will continue R&D efforts to make these energy sources more cost-competitive. Last year's budget provided $150 million to existing coal research towards the President's commitment to spend $2 billion over ten years on clean coal research. In the 2003 budget, all coal programs are brought under one umbrella—the President's Clean Coal Research Initiative. Using a more transparent budget structure, this approach will improve the management and oversight of this $326 million program.

DOE also sponsors R&D to improve the energy efficiency of buildings, industry, the transportation sector, and the federal government ($589 million in 2003). DOE's energy conservation efforts include the following examples. Cost-shared R&D with industry will to continue to increase industrial output per unit of energy input. Development of a web-based tool will assist contractors and homeowners in identifying the most efficient energy-saving retrofit activities, based on the age and condition of the home and the funds available. A partnership with the trucking industry will dramatically improve fuel efficiency by 2010. And, a program to increase energy efficiency in federal buildings will achieve a 35 percent efficiency increase by 2010, compared to 1985 levels.

Department of Defense: DOD funds a wide range of R&D to ensure that our military forces have the tools to protect the Nation's security. DOD's 2003 budget includes $5.0 billion that appears in the FS&T budget.

Due in part to the events of September 11, 2001, research and development of technologies and systems that address terrorist threats have been the focus of additional funds and urgency. Systems or technologies under development include: improved detectors of chemical and biological threats (for both remote and on-site application); more comfortable and more effective troop protective gear for use under chemical and bio-

logical attack; vaccines to provide protection against biological agents; surveillance systems to provide longer range and earlier warning of possible attacks using weapons of mass destruction; and more effective cave and other "hard target" attack munitions.

DOD's "Science and Technology" programs (over $9 billion in 2003) range from basic research and applied research (included in FS&T), to fabrication of component prototypes for potential future systems. These programs explore and develop technical options for new defense systems and help reduce the chance of being surprised by new technologies in the hands of adversaries. Areas of emphasis include computing and communications, sensors, nanotechnology, understanding the military environment (for example, oceans, atmospheric and geological sciences), propulsion systems, and technologies for the next generation of long-range strike aircraft. Promising technologies and processes may be incorporated into weapon systems of the future.

Later stage development, test and evaluation funds ($45 billion) support development of new weapons and supporting systems, including testing the effectiveness of those systems and how they interface with other weapons or control systems. Systems under development in 2003 include: the Joint Strike Fighter, ballistic missile defense systems, a new aircraft carrier, the DD(X) naval destroyer, space-based missile warning satellites, and unmanned underwater vehicles. Systems in the final stages of development include the F–22 fighter aircraft and the V–22 Osprey tilt-rotor aircraft. The Army continues development efforts in support of the Future Combat System as a major part of their transformation to a lighter, more mobile, and more effective fighting force.

Department of Agriculture: The 2003 budget provides $1.9 billion, a one percent increase, for FS&T at the Department of Agriculture (USDA). The budget for USDA's research, education and extension programs proposes significant increases for high priority national needs and for competitive, peer-reviewed grants, while reducing or eliminating lower priority projects, particularly earmarks. Funded at $2.3 billion in 2003, this program includes activities that are not part of the FS&T budget, such as USDA laboratory construction and rehabilitation, extension grants, and statistical programs. The 2003 budget adds $58 million to the programs of the Agricultural Research Service (ARS) in the following areas: air and water quality and climate change, biobased products, bioenergy and biotechnology, protection against bioterrorism, emerging and exotic diseases, genomics and genetics, and library resources. In addition, the budget provides $240 million (a 100 percent increase) for the National Research Initiative (NRI), which funds competitive research grants covering a broad spectrum of agricultural research areas. The budget provides additional increases over 2002 of $7 million for the expansion of the Agricultural Resources Management Study and of $15.5 million for necessary cyclical costs associated with the five year Census of Agriculture.

The 2003 budget for Forest Service Research and Development programs ($254 million) includes $10 million for new priority research on biobased products and bioenergy and a quantitative planning and graphic data analysis tool for forest planning. The budget also places additional emphasis on annualized forest inventories.

In order to fund these increases and ensure that taxpayer dollars are used most effectively in the public interest, the budget proposes to eliminate unrequested earmarks for specific purposes at specific locations that were provided in 2002. These total $205 million for in-house research ($89 million in ARS and $16 million in the Forest Service) and $123 million for research grants, for a total of over 400 projects.

Department of the Interior: Within the Department of the Interior (DOI), the 2003 budget provides $904 million for the United States Geological Survey (USGS), for science that emphasizes the mission responsibility of providing sound and impartial science to manage land, water, biological, energy, and mineral resources. The 2003 budget reduces direct federal funding for programs that support outside customers in order to increase the proportion of services paid for by these customers. The 2003 budget focuses resources on those programs that directly address the science needs of Interior bureaus, including funding for science to support ecosystem restoration in the Everglades. To support sound conservation decisions, USGS will combine natural resource monitoring and information technology that will promote conservation partnerships and better inform federal, state, and local land acquisition.

The budget transfers USGS toxic substances hydrology research program funding to NSF. While the work of USGS is generally of high quality, this transfer will provide new emphasis on merit-based competitive selection. USGS will continue to play a role in identifying research priorities.

Beginning in 2002, the Bureau of Land Management and USGS will help support the development of the E-Gov Geospatial One-Stop initiative. This initiative, led by the interagency Federal Geographic Data Committee, will make geospatial data more accessible and usable by developing government-wide data standards and deploying a user friendly web portal for geospatial data and mapping applications.

Department of Commerce: The 2003 budget provides $861 million for FS&T at the Department of Commerce (DOC). For the National Institute of Standards and Technology (NIST), the budget provides $402 million—a 23 percent increase over 2002—for research and physical improvements at NIST's Measurement and Standards Laboratories. In addition to funding ongoing research, the budget increase supports construction of new NIST facilities, including equipment for the Advanced Measurement Laboratory in Maryland. NIST labs work with industry to develop the measurements and standards needed to support technological innovation. Facilities modernization is needed to support NIST's groundbreaking research.

The 2003 budget also provides $107 million for NIST's Advanced Technology Program (ATP), which makes R&D grants to commercial firms. In 2003, ATP will modify its program regulations to increase university participation and allow cost-recoupment for successfully commercialized technologies.

The 2003 budget provides $297 million for FS&T at the National Oceanic and Atmospheric Administration (NOAA) to improve understanding of climate change, weather and air quality, and ocean processes. In 2003, NOAA's R&D will also support economic growth through continued efforts in marine biotechnology and aquaculture, as well as a new initiative to demonstrate benefits to the energy sector through improved weather and river forecasting capabilities. The budget also transfers the National Sea Grant College Program to NSF to promote more rigorous, merit-based competition among researchers. NOAA and NSF will jointly manage the program, and NOAA will continue to play a role in identifying research priorities.

Environmental Protection Agency: The budget provides $797 million for FS&T at the Environmental Protection Agency (EPA). The Office of Research and Development (ORD) performs the majority of EPA's research and provides a sound scientific and technical foundation for environmental policy and regulatory decision-making. EPA relies on strong science to achieve its mission and has a responsibility to ensure that efforts to reduce environmental risks are based on the best available scientific information. In 2003, EPA will work to improve methods for assessing the cumulative risks of complex pollutant mixtures, tools to describe the impact of exposures to them on cumulative risk, and the tools for decision makers to address cumulative risks. EPA will also focus essential scientific support on its highest-priority pending regulations to help strengthen its regulatory process. A new EPA effort to identify innovative environmental technologies through a national competition is expected to help solve such vexing problems as effluent trading programs and removing arsenic from drinking water. EPA will also fund a new biotechnology research effort to address information gaps and develop management tools for allergenicity, and ecological risk and resistance. The budget includes $75 million for research into technologies and procedures to cope with future biological or chemical incidents.

Department of Transportation: The 2003 budget provides $548 million for FS&T at the Department of Transportation (DOT). DOT research funds are concentrated primarily in the federal Highway Administration (FHWA), the National Highway Traffic Safety Administration (NHTSA), and the Federal Airline Administration (FAA). The FHWA ($421 million in 2003) supports research to improve the quality and safety of the Nation's transportation infrastructure. Specifically, the research focuses on methods to increase the quality and longevity of roadways, identifies safety improvements possible through the use of Intelligence Transportation Systems (ITS), and analyzes the use of surveillance technology for improved traffic control, emergency evacuations and critical infrastructure. NHTSA's 2003 budget provides $58 million for R&D in crash worthiness, crash avoidance and data analysis to help reduce highway fatalities and injuries.

In aviation research, and in light of the September 11th terrorist attacks, security will be the major focus for the FAA as it develops the best technologies to prevent future incidents. The 2003 budget provides $95 million for aviation security technology research.

Department of Education: The 2003 budget provides $431 million for FS&T at the Department of Education. The vast majority of the Department's research and development is administered by three offices: the Office of Educational Research and Improvement (OERI), National Institute for Disability and Rehabilitation Research (NIDRR), and the Office of Special Education Programs (OSEP).

OERI, which administers the largest share of FS&T funds through Research, Development, and Dissemination, conducts research on teaching, learning and achievement; develops materials and methods to help students succeed; and disseminates these techniques to teachers and schools. In 2003, OERI's research portfolio will include a program that builds on the substantial science of reading to study conditions under which children decode and ultimately comprehend what they read. A second new program will support trials of existing preschool curricula to identify which work best. A third will identify strategies to enhance the use of research findings by teachers, school administrators, and policymakers.

The Administration is developing a reauthorization proposal for OERI that will address many of its perennial research quality issues through structural reform. The new structure should allow OERI to improve the quality, objectivity, coordination, and focus of the Department's research activities. Until reauthorizing legislation is enacted, the Assistant Secretary is improving the scientific quality of OERI-funded research projects through implementation of a more rigorous grant solicitation and peer review process.

The Office of Special Education and Rehabilitative Services administers R&D related to persons with disabilities through NIDRR and OSEP. NIDRR conducts research and related activities to maximize the full integration, employment, and independent living of individuals with disabilities, consistent with the President's New Freedom Initiative, which aims to help individuals with disabilities lead more independent lives.

OSEP supports special education research projects, demonstrations, and outreach in order to produce new knowledge in the fields of special education and early intervention, apply effective research in model demonstration projects, and put knowledge into the hands of those who work with children with disabilities.

Department of Veterans Affairs: The 2003 budget provides $409 million for FS&T at the Department of

Veterans Affairs (VA), an increase of 10 percent. In addition, the Department receives significant funding from other governmental agencies and private entities to support VA-conducted research, which brings the total of R&D VA performs to $1.4 billion. The 2003 budget provides $394 million for clinical, epidemiological, and behavioral studies across a broad spectrum of medical research disciplines. Among the agency's top research priorities are improving the translation of research results into patient care, special populations (those afflicted with spinal cord injury, visual and hearing impairments, and serious mental illness), geriatrics, diseases of the brain (e.g., Alzheimer's and Parkinson's disease), treatment of chronic progressive multiple sclerosis, and chronic disease management.

Stimulating Private Investment

Along with direct spending on R&D, the federal government has sought to stimulate private investment in these activities with tax preferences. The current law provides a 20-percent tax credit for private research and experimentation expenditures above a certain base amount. The credit, which expired in 1999, was retroactively reinstated for five years, to 2004, in the Tax Relief Extension Act of 1999. The budget proposes to make the Research and Experimentation (R&E) tax credit permanent. The proposed extension will cost $14 billion over the period from 2004 to 2007. In addition, a permanent tax provision lets companies deduct, up front, the costs of certain kinds of research and experimentation, rather than capitalize these costs. Finally, equipment used for research benefits from relatively rapid cost recovery.

Table 8–1 shows a forecast of the costs of the tax credit.

Table 8–1. PERMANENT EXTENSION OF THE RESEARCH AND EXPERIMENTATION TAX CREDIT

(Budget authority, dollar amounts in millions)

	2003	2004	2005	2006	2007	2003–2007
Current Law	4,590	4,020	2,330	990	410	12,350
Proposed Extension	0	906	2,949	4,654	5,623	14,132
Total	**4,590**	**4,926**	**5,279**	**5,644**	**6,033**	**26,482**

IV. FEDERAL R&D DATA

Federal R&D Funding

R&D is the collection of efforts directed towards gaining greater knowledge or understanding and applying knowledge toward the production of useful materials, devices, and methods. R&D investments can be characterized as basic research, applied research, development, R&D equipment, or R&D facilities, and OMB has used those or similar categories in its collection of R&D data since 1949.

Basic research is defined as systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.

Applied research is systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.

Development is systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

Research and development equipment includes acquisition or design and production of movable equipment, such as spectrometers, microscopes, detectors, and other instruments.

Research and development facilities include the acquisition, design, and construction of, or major repairs or alterations to, all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the Government or by a private organization, and regardless of where title to the property may rest. This category includes such fixed facilities as reactors, wind tunnels, and particle accelerators.

There are over twenty federal agencies that fund R&D in the U.S. The nature of the R&D that these agencies fund depends on the mission of each agency and on the role of R&D in accomplishing it. Table 8–2 shows agency-by-agency spending on basic and applied research, development, and R&D equipment and facilities.

Table 8–2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING

(Budget authority, dollar amounts in millions)

	2000 Actual	2001 Actual	2002 Estimate	2003 Proposed	Dollar Change: 2002 to 2003	Percent Change: 2002 to 2003
By Agency						
Defense	39,664	42,235	49,171	54,544	5,373	11%
Health and Human Services	18,051	21,037	23,938	27,683	3,745	16%
National Aeronautics and Space Administration	9,242	9,675	9,560	10,069	509	5%
Energy	6,892	7,772	9,253	8,510	–743	–8%
National Science Foundation	2,947	3,363	3,571	3,700	129	4%
Agriculture	1,773	2,182	2,336	2,118	–218	–9%
Commerce	1,110	1,054	1,129	1,114	–15	–1%
Veterans Affairs	618	748	796	846	50	6%
Transportation	603	792	867	725	–142	–16%
Environmental Protection Agency	559	598	612	650	38	6%
Interior	645	622	660	628	–32	–5%
Education	238	264	268	311	43	16%
Other	796	922	1,021	858	–163	–16%
Total	**83,138**	**91,264**	**103,182**	**111,756**	**8,574**	**8%**
Basic Research						
Defense	1,136	1,271	1,305	1,336	31	2%
Health and Human Services	10,062	11,601	13,183	14,467	1,284	10%
National Aeronautics and Space Administration	2,137	1,652	1,909	2,298	389	20%
Energy	2,262	2,390	2,420	2,517	97	4%
National Science Foundation	2,540	2,894	3,093	3,242	149	5%
Agriculture	684	801	860	880	20	2%
Commerce	42	50	52	73	21	40%
Veterans Affairs	52	301	344	367	23	7%
Transportation	10	17	13	25	12	92%
Environmental Protection Agency	58	105	107	101	–6	–6%
Interior	266	56	58	55	–3	–5%
Education	2	2	2	1	–1	–50%
Other	170	190	196	183	–13	–7%
Subtotal	**19,421**	**21,330**	**23,542**	**25,545**	**2,003**	**9%**
Applied Research						
Defense	3,405	3,673	3,656	3,616	–40	–1%
Health and Human Services	7,692	9,064	10,249	12,379	2,130	21%
National Aeronautics and Space Administration	1,534	2,533	2,766	3,099	333	12%
Energy	1,874	2,330	2,874	2,866	–8	0%
National Science Foundation	184	181	192	199	7	4%
Agriculture	831	1,045	988	946	–42	–4%
Commerce	780	768	838	795	–43	–5%
Veterans Affairs	520	432	436	462	26	6%
Transportation	396	445	522	396	–126	–24%
Environmental Protection Agency	388	370	381	431	50	13%
Interior	367	534	570	541	–29	–5%
Education	151	172	178	212	34	19%
Other	344	413	432	348	–84	–19%
Subtotal	**18,466**	**21,960**	**24,082**	**26,290**	**2,208**	**9%**
Development						
Defense	35,026	37,270	44,200	49,570	5,370	12%
Health and Human Services	44	107	129	100	–29	–22%
National Aeronautics and Space Administration	2,702	2,698	2,582	2,648	66	3%
Energy	1,855	2,042	2,851	2,162	–689	–24%
National Science Foundation	0	0	0	0	0	N/A
Agriculture	111	152	163	156	–7	–4%
Commerce	130	170	162	109	–53	–33%
Veterans Affairs	29	15	16	17	1	6%
Transportation	185	247	256	221	–35	–14%
Environmental Protection Agency	92	101	103	97	–6	–6%
Interior	12	32	32	32	0	0%
Education	85	90	88	98	10	11%
Other	253	306	378	310	–68	–18%
Subtotal	**40,524**	**43,230**	**50,960**	**55,520**	**4,560**	**9%**
Facilities and Equipment						
Defense	97	21	10	22	12	120%
Health and Human Services	253	265	377	737	360	95%

Table 8–2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING—Continued

(Budget authority, dollar amounts in millions)

	2000 Actual	2001 Actual	2002 Estimate	2003 Proposed	Dollar Change: 2002 to 2003	Percent Change: 2002 to 2003
National Aeronautics and Space Administration	2,869	2,792	2,303	2,024	–279	–12%
Energy	901	1,010	1,108	965	–143	–13%
National Science Foundation	223	288	286	259	–27	–9%
Agriculture	147	184	325	136	–189	–58%
Commerce	158	66	77	137	60	78%
Veterans Affairs	17	0	0	0	0	N/A
Transportation	12	83	76	83	7	9%
Environmental Protection Agency	21	22	21	21	0	0%
Interior	0	0	0	0	0	N/A
Education	0	0	0	0	0	N/A
Other	29	13	15	17	2	13%
Subtotal	**4,727**	**4,744**	**4,598**	**4,401**	**–197**	**–4%**

Federal Science and Technology Budget

Table 8–3 contains the FS&T budget, which accounts for nearly all of federal basic research, over 80 percent of federal applied research, and about half of civilian development.

Table 8–3. FEDERAL SCIENCE AND TECHNOLOGY BUDGET

(Budget authority, dollar amounts in millions)

	2000 Actual	2001 Actual	2002 Estimate	2003 Proposed	Dollar Change: 2002 to 2003	Percent Change: 2002 to 2003
By Agency						
National Institutes of Health [1]	**17,827**	**20,438**	**23,433**	**27,335**	**3,902**	**17%**
NASA [2]	**7,013**	**7,789**	**8,113**	**8,774**	**661**	**8%**
Space Science	2,606	2,760	3,034	3,428	394	13%
Earth Science	1,734	1,825	1,695	1,639	-56	-3%
Biological and Physical Research	839	944	828	851	23	3%
Aero-space Technology	1,834	2,260	2,556	2,856	300	12%
National Science Foundation	**3,903**	**4,437**	**4,795**	**5,036**	**241**	**5%**
Energy	**4,338**	**4,911**	**5,099**	**5,027**	**-72**	**-1%**
Science Programs [3]	2,820	3,218	3,240	3,285	45	1%
Renewable Energy	306	370	386	408	22	6%
Nuclear Energy	226	261	244	251	7	3%
Energy Conservation [4]	577	619	641	589	-52	-8%
Fossil Energy [5]	409	443	588	494	-94	-16%
Defense	**4,541**	**4,944**	**4,961**	**4,952**	**-9**	**0%**
Basic Research	1,136	1,271	1,305	1,336	31	2%
Applied Research	3,405	3,673	3,656	3,616	-40	-1%
Agriculture	**1,759**	**1,885**	**1,890**	**1,913**	**23**	**1%**
CSREES Research and Education	488	514	552	563	11	2%
Economic Research Service	67	69	70	82	12	17%
Mandatory Research Grants [6]	120	120	0	0	0	N/A
Agricultural Research Service [7]	866	936	1,017	1,014	-3	0%
Forest Service [8]	218	246	251	254	3	1%
Interior (USGS)	**847**	**918**	**950**	**904**	**-46**	**-5%**
Commerce	**826**	**828**	**948**	**861**	**-87**	**-9%**
NOAA (Oceanic and Atmospheric Research) [9]	285	325	362	297	-65	-18%
NIST [10]	541	503	586	564	-22	-4%
Environmental Protection Agency [11]	**683**	**746**	**750**	**797**	**47**	**6%**
Transportation	**593**	**521**	**651**	**548**	**-103**	**-16%**
Highway research [12]	490	387	448	421	-27	-6%
Aviation research [13]	103	134	203	127	-76	-37%
Education	**317**	**363**	**377**	**431**	**54**	**14%**
Special Education Research and Innovation	64	77	78	78	0	0%
NIDRR [14]	86	100	110	110	0	0%
Research, Development, and Dissemination	167	186	189	243	54	29%

Table 8–3. FEDERAL SCIENCE AND TECHNOLOGY BUDGET—Continued

(Budget authority, dollar amounts in millions)

	2000 Actual	2001 Actual	2002 Estimate	2003 Proposed	Dollar Change: 2002 to 2003	Percent Change: 2002 to 2003
Veterans Affairs [15]	**321**	**363**	**373**	**409**	**36**	**10%**
Total	**42,968**	**48,143**	**52,340**	**56,987**	**4,647**	**9%**

Notes: Levels adjusted to include the full share of accruing employee pensions and annuitants health benefits. For more information on these items, please see Chapter 14. Levels for 2000 are derived without accrual in most instances.

[1] The 2002 appropriation includes $100 million for the Global Fund to Fight HIV/AIDS, Turberculosis, and Malaria.
[2] All years normalized to reflect 2003 transfers of funding for Space Station research facilities, space communications activities, and associated institutional support from human space flight.
[3] Includes $36 million for programs transferred from Environmental Management.
[4] Excludes state grant programs.
[5] Excludes balances tranferred from the Clean Coal Technology program for activities in 2001 ($95 million), 2002 ($34 million), and 2003 ($40 million).
[6] Initiative for Future Agriculture and Food Systems.
[7] Excludes buildings and facilities.
[8] Forest and Rangeland Research.
[9] Excludes Manufacturing Extension Program.
[10] The 2003 level does not include the Sea Grant program, which was transferred to NSF.
[11] Science and Technology, plus superfund transfer. The 2002 level does not include anti-terrorism supplemental funding, which is primarily for drinking water vulnerability standards. The 2003 level includes an additional superfund transfer for security research related to building decontamination.
[12] Includes research and development funding for the Federal Highway Administration, the Federal Motor Carrier Safety Administration, and the National Highway Traffic Safety Administration.
[13] Federal Aviation Administration Research, Engineering, and Development. Excludes funding for aviation security research in all years, now funded through the Transportation Security Administration.
[14] National Institute on Disability and Rehabilitation Research.
[15] Medical and Prosthetic Research.

Interagency R&D Efforts

Table 8–4 shows agency spending for Networking and Information Technology R&D, the National Nanotechnology Initiative, and the climate change research and technology initiatives.

Table 8–4. AGENCY DETAIL OF SELECTED INTERAGENCY R&D EFFORTS

(Budget authority, dollar amounts in millions)

	2001 Actual	2002 Estimate	2003 Proposed	Dollar Change: 2002 to 2003	Percent Change: 2002 to 2003
Networking and Information Technology R&D					
National Science Foundation	636	676	678	2	0%
Health and Human Services	277	310	336	26	8%
Energy	326	312	313	1	0%
Defense	310	320	306	–14	–4%
National Aeronautics and Space Administration	177	181	213	32	18%
Commerce	38	43	42	–1	–2%
Environmental Protection Agency	4	2	2	0	0%
Total	**1,768**	**1,844**	**1,890**	**46**	**3%**
National Nanotechnology Initiative					
National Science Foundation	150	199	221	22	11%
Defense	125	180	201	21	12%
Energy	88	91	139	48	53%
Commerce	33	38	44	6	16%
National Institutes of Health	40	41	43	2	6%
National Aeronautics and Space Administration	22	22	22	0	0%
Environmental Protection Agency	5	5	5	0	0%
Department of Transportation	0	2	2	0	0%
Department of Justice	1	1	1	0	0%
Total	**464**	**579**	**679**	**100**	**17%**
Climate Change Research Initiative.					
Commerce	0	0	18	18	N/A
National Science Foundation	0	0	15	15	N/A
National Aeronautics and Space Administration	0	0	3	3	N/A
Energy	0	0	3	3	N/A
Agriculture	0	0	1	1	N/A
Total	**0**	**0**	**40**	**40**	**N/A**
U.S. Global Change Research Program					
National Aeronautics and Space Administration	1,176	1,090	1,109	19	2%
National Science Foundation	181	188	188	0	0%
Energy	116	120	126	6	5%

Table 8–4. AGENCY DETAIL OF SELECTED INTERAGENCY R&D EFFORTS—Continued

(Budget authority, dollar amounts in millions)

	2001 Actual	2002 Estimate	2003 Proposed	Dollar Change: 2002 to 2003	Percent Change: 2002 to 2003
Commerce	93	100	100	0	0%
National Institutes of Health	54	60	68	8	13%
Agriculture	51	56	66	10	18%
Interior	27	28	28	0	0%
Environmental Protection Agency	23	21	22	1	5%
Smithsonian	7	7	7	0	0%
Total	**1,728**	**1,670**	**1,714**	**44**	**3%**

*Includes $9 million in offsetting collections in 2003 for the Agency for Healthcare Research and Quality. These activities were funded at $15 million in 2001 and $14 million in 2002.

Allocation of Research Funding

Federal funds appropriated to Executive Branch agencies may be used in different ways, ranging from grants awarded to university researchers to supporting research at federal laboratories. The Administration supports the competitive, merit review process for funding research in most cases. However, there are appropriate roles for other modes of allocating research funding in some circumstances, such as funding research at specific facilities that have unique capabilities.

In order to better understand and characterize the methods agencies use to allocate their research funding, agencies reported how research funds are allocated by the following five categories:

Research performed at congressional direction consists of intramural and extramural research programs where funded activities are awarded to a single performer or collection of performers with limited or no competitive selection or with competitive selection but outside of the agency's primary mission, based on direction from the Congress in law, in report language, or by other direction.

Inherently unique research is intramural and extramural research programs where funded activities are awarded to a single performer or team of performers without competitive selection. The award may be based on the provision of unique capabilities, concern for timeliness, or prior record of performance (e.g., facility operations support for a unique facility, such as an electron-positron linear collider; research grants for rapid response studies such as Pfisteria, an environmental hazard that arose suddenly).

Merit-reviewed research with limited competitive selection is intramural and extramural research programs where funded activities are competitively awarded from a pool of qualified applicants that are limited to organizations that were created to largely serve federal missions and continue to receive most of their annual research revenue from federal sources. The limited competition may be for reasons of stewardship, agency mission constraints, or retention of unique technical capabilities (e.g., funding set aside for researchers at laboratories or centers of DOD, NASA, EPA, NOAA, and NIH; Federally-Funded Research and Development Centers; formula funds for USDA).

Merit-reviewed research with competitive selection and internal (program) evaluation is intramural and extramural research programs where funded activities are competitively awarded following review for scientific or technical merit. The review is conducted by the program manager or other qualified individuals from within the agency program, without additional independent evaluation (e.g., merit-reviewed research at DOD).

Merit-reviewed research with competitive selection and external (peer) evaluation is intramural and extramural research programs where funded activities are competitively awarded following review by a set of external scientific or technical reviewers (often called peers) for merit. The review is conducted by appropriately qualified scientists, engineers, or other technically-qualified individuals who are apart from the people or groups making the award decisions, and serves to inform the program manager or other qualified individual who makes the award (e.g., NSF's single-investigator research; NASA's research and analysis funds).

Table 8–5 lists how federal R&D agencies report allocating research funding among these categories.

Table 8–5. ALLOCATION OF FEDERAL RESEARCH FUNDING, 2001 and 2002

(Budget authority, dollar amounts in millions)

	Research Performed at Congressional Direction		Inherently Unique Research		Merit-Reviewed Research with Limited Competitive Selection		Merit-Reviewed Research with Competitive Selection and Internal Evaluation		Merit-Reviewed Research with Competitive Selection and External Evaluation		Total	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
By Agency												
Health and Human Services	89	142	206	230	2,392	2,718	201	216	17,777	20,126	20,665	23,432
Energy	134	223	1,078	1,068	2,382	2,820	305	395	821	788	4,720	5,294
Defense*	678	426	295	350	1,012	1,014	2,712	2,950	247	221	4,944	4,961
National Aeronautics and Space Administration	230	287	152	149	532	398	1,377	1,550	1,894	2,291	4,185	4,675
National Science Foundation	0	0	0	0	191	206	184	192	2,700	2,887	3,075	3,285
Agriculture**	105	122	815	893	720	676	0	0	206	157	1,846	1,848
Commerce	18	21	354	377	100	108	204	218	142	166	818	890
Veterans Affairs	1	0	0	0	2	2	349	370	381	408	733	780
Interior	27	48	156	154	379	392	26	31	2	3	590	628
Transportation	55	82	69	73	0	0	338	380	0	0	462	535
Environmental Protection Agency	39	60	39	38	195	192	69	68	133	130	475	488
Education	5	0	0	0	0	0	0	0	169	180	174	180
Smithsonian Institution	0	0	108	111	0	0	0	0	0	0	108	111
Other	385	413	11	7	17	17	76	74	6	6	495	517
Total	**1,766**	**1,824**	**3,283**	**3,450**	**7,922**	**8,543**	**5,841**	**6,444**	**24,478**	**27,363**	**43,290**	**47,624**

*Allocation among categories is preliminary.
**Does not include net mandatory funding for USDA research grant programs of $120 million in FY 2001.

Earmarks

Table 8–6 lists the top 30 recipients of individual academic earmarks in 2001, as identified by *The Chronicle of Higher Education*. In addition to $1.2 billion in earmarks to specific colleges and universities, there is another $431 million in earmarked funding to be shared in an unspecified distribution among these and other colleges and universities.

Table 8–6. 30 Colleges and Universities Received Over 40 Percent of Unshared* Academic Earmarks in 2001

Table 8–6. COLLEGES AND UNIVERSITIES RECEIVED OVER 40 PERCENT OF UNSHARED* ACADEMIC EARMARKS IN 2001

College or University	State	Number of Earmarks Received	Sum of Earmarks* (millions)
1. University of Alaska at Fairbanks	Alaska	20	$35.0
2. Loma Linda University	California	4	$35.0
3. Marshall University	West Virginia	6	$27.6
4. University of New Hampshire	New Hampshire	14	$27.5
5. Dartmouth College	New Hampshire	5	$25.9
6. University of Missouri at Columbia	Missouri	21	$23.7
7. University of Mississippi	Mississippi	20	$23.7
8. University of Alabama at Birmingham	Alabama	12	$22.1
9. University of Nebraska	Nebraska	4	$19.5
10. Kansas State University	Kansas	12	$18.3
11. University of Florida	Florida	14	$18.3
12. Mississippi State University	Mississippi	33	$18.2
13. Pennsylvania State University at University Park	Pennsylvania	14	$16.7
14. Wheeling Jesuit University	West Virginia	9	$16.3
15. University of Maine	Maine	9	$16.2
16. West Virginia University	West Virginia	17	$15.6
17. Auburn University	Alabama	17	$15.2
18. University of South Carolina at Columbia	South Carolina	6	$14.6
19. Southern Illinois University at Edwardsville	Illinois	3	$14.3
20. University of Alabama at Tuscaloosa	Alabama	10	$14.2
21. University of South Florida	Florida	8	$13.2
22. University of Minnesota—Twin Cities	Minnesota	5	$12.7
23. University of Louisville	Kentucky	9	$12.5

Table 8–6. COLLEGES AND UNIVERSITIES RECEIVED OVER 40 PERCENT OF UNSHARED* ACADEMIC EARMARKS IN 2001—Continued

College or University	State	Number of Earmarks Received	Sum of Earmarks* (millions)
24. New Mexico Institute of Mining and Technology	New Mexico	7	$12.5
25. University of Southern Mississippi	Mississippi	11	$11.8
26. Montana State University at Bozeman	Montana	17	$11.1
27. Washington State University	Washington	18	$10.5
28. University of Hawaii, Manoa	Hawaii	20	$10.4
29. Medical University of South Carolina	South Carolina	3	$10.0
30. University of Miami	Florida	4	$9.5

*Totals do not include earmarks split among institutions, where the distribution was not specified.