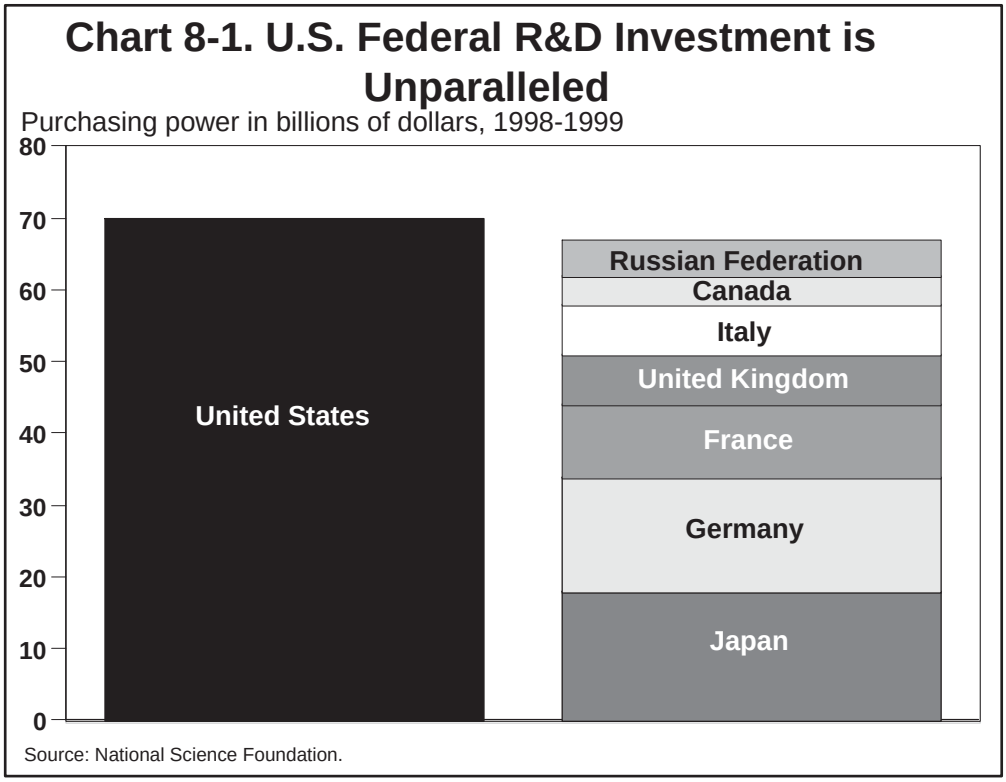
8. RESEARCH AND DEVELOPMENT

I. Introduction

Author Jean-Paul Kauffmann has observed, "The economy depends about as much on economists as the weather does on weather forecasters." The same cannot be said of those who perform scientific and technological research. Scientific discovery and technological innovation generate countless advancements in our understanding of the world around us. They improve the quality of life. Science and technology have generated much of the nation's economic growth over the last 50 years. These advances have been possible only through both public and private investment in research and development (R&D).

The R&D investment of the United States is unparalleled. Not only does the U.S. continue to lead the world in government-supported R&D spending, but U.S. federal R&D expenditures exceed those of the rest of the G-8 countries' governments combined, as the most recent data indicate in the accompanying figure.



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 2004 Budget focuses on winning the war against terrorism, 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 are directing many of their programs to assist in the defense effort, some of which are being transferred to the Department of Homeland Security (DHS). Investments today in R&D will translate into tomorrow's capabilities for detecting threats to our security, defending ourselves against them, and responding to emergencies should they arise.

The 2004 Budget provides the highest level of federal 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. We must redouble our efforts to meet the President's charge to improve

the management, performance, and results of the federal government. By strengthening effective programs and addressing lower performers through reforms or shifting funds to higher performers, we will increase the productivity of the federal R&D portfolio and transcend the all-too-common focus on 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—agencies can establish meaningful program goals and measure annual progress and performance in appropriate ways. Toward that end, the Administration is continuing to implement and improve investment criteria for R&D programs across the government. Finally, the government will coordinate interrelated and complementary R&D efforts among agencies, combining programs where appropriate to improve effectiveness and eliminate redundancy, 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, which by definition is directed toward greater understanding of fundamental phenomena without specific applications in mind. Basic research is the source of tomorrow's discoveries and new capabilities, and this long-term research will fuel further gains in economic productivity, quality of life, and national security. The government should also support applied research, which is defined as research meant to address specific needs, and development, which applies scientific knowledge and technology to specific needs. Together, this R&D is 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 broad 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 proposes to do this, for instance, by permanently extending the Research and Experimentation tax credit.

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 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 Criteria

The Administration is improving the effectiveness of the federal government's investments in R&D by applying transparent investment criteria and considering the expected results of program funding recommendations. R&D—especially basic research—requires special consideration in the context of performance assessment. Rocket pioneer Werner von Braun once explained, "Basic research is what I'm doing when I don't know what I'm doing." Research often leads scientists and engineers down unpredictable pathways with unpredictable results. This poses a difficult problem for determining research priorities in a budget. Adopting ideas first laid out by the National Academy of Sciences, the Administration is improving methods for how to set priorities based on expected results, including applying specific criteria that programs or projects must meet to be started or continued, clear milestones for gauging progress, and improved metrics for assessing results.

As announced in the President's Management Agenda, the investment criteria were first applied in 2001 to selected R&D programs at the Department of Energy (DOE). Through the lessons learned from that DOE pilot, this year the criteria were broadened in scope to cover other types of R&D programs at DOE and other agencies.

To accommodate the scope of a wide range of R&D activities ranging from basic research to development and demonstration programs, a new framework was devised for the criteria to address three fundamental aspects of R&D:

- *Relevance*—Programs must be able to articulate why investments are important, relevant, and appropriate;
- *Quality*—Programs must justify how funds will be allocated to ensure quality; and
- *Performance*—Programs must be able to monitor and document how well the investments are performing.

In addition, R&D projects and programs relevant to industry are expected to meet additional criteria to determine the appropriateness of the public investment, enable comparisons of proposed and demonstrated benefits, and provide meaningful decision points for completing or transitioning the activity to the private sector.

Broader Application of the R&D Investment Criteria. This was the first year of implementation of the investment criteria for most R&D agencies. The National Aeronautics and Space Administration is recasting its strategic plans and budget to tie directly to the R&D criteria. To reflect the criteria, the National Science Foundation is changing the way it characterizes its budget, as well as the guidelines it uses to evaluate its research. The National Institutes of Health have dramatically, revised their research performance goals to be both clearer and more ambitious. Several agencies' R&D programs were assessed using a Program Assessment Rating Tool (PART) that was based on the R&D criteria (see the Performance and Management Assessments volume of the budget for more details). The R&D agencies have more work to do to integrate the R&D criteria more meaningfully into their management processes and budget decisions.

The Administration has been studying management strategies for R&D that some agencies use to promote particularly effective programs. The Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP) are continuing to assess the strengths and weaknesses of R&D programs across agencies, in order to identify and apply good R&D management practices throughout the government. For example, some agencies have a more deliberate project-prioritization process, while other agencies have more experience estimating the returns of R&D and assessing the impact of prior investments. Assessing and implementing new approaches is an iterative process, involving the research agencies and the science and technology community.

As the investment criteria are implemented more broadly and more deeply, one theme that occurs again and again is the importance of coordination and partnerships. First, partnerships are relevant to the question of the proper federal role. These include partnerships with industry (such DOE's coal and FreedomCAR R&D initiatives), partnerships with other countries (such as for the International Thermonuclear Experimental Reactor initiative for fusion energy), and partnerships with university researchers. In a different sense, partnerships and coordination across agencies can make the use of research resources more efficient and effective. The themes of coordination and partnerships will be pursued more explicitly in further implementation of the investment criteria.

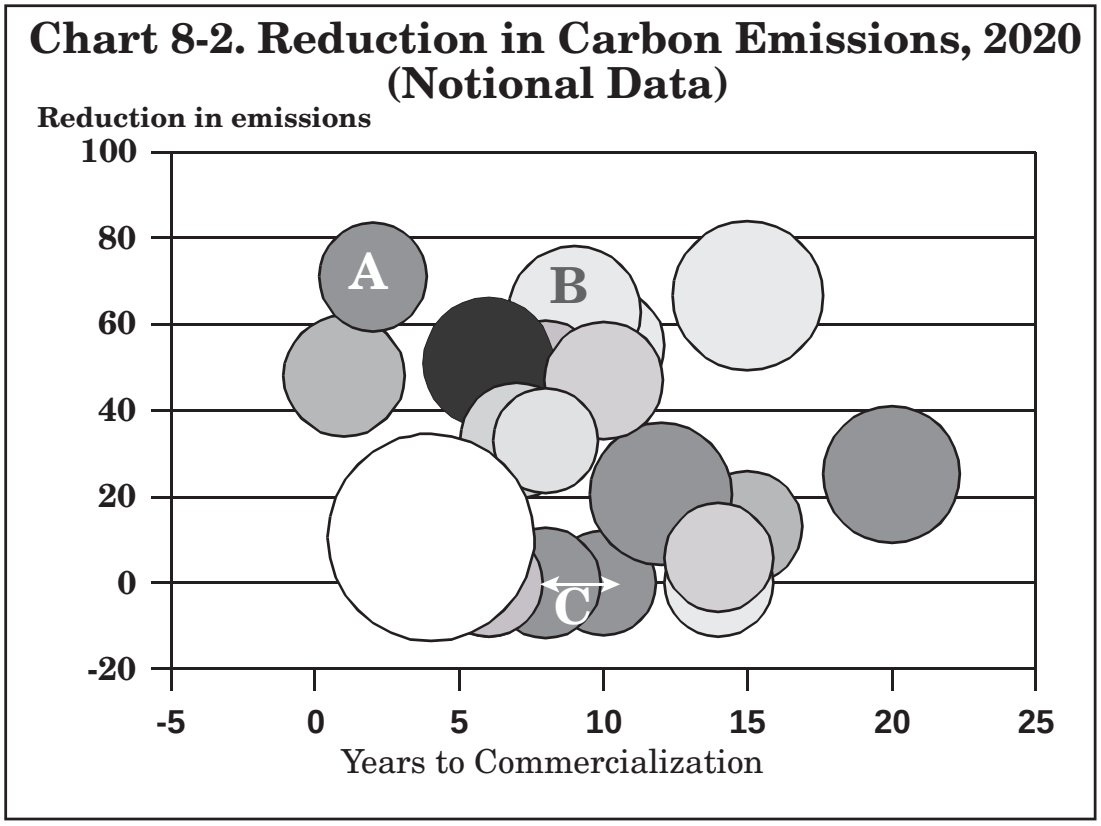
Year Two in DOE Implementation of the Criteria. DOE used the criteria to evaluate 80 applied research projects and programs, and the results of these evaluations guided the budget's allocation of funds among programs. In some cases, the evaluation resulted in shifting funding from activities supporting technologies that are near commercialization, such as clean coal demonstration projects, to long-term, high-risk R&D, such as research on revolutionary new ways to store large amounts of hydrogen in a small space, which will help advance the introduction of fuel cell vehicles.

Application of the criteria in DOE programs also led to recommendations to terminate or redirect funding from some activities, either because the case for federal participation was weak or other higher-priority research activities could use these funds more effectively. For example, the budget proposes to significantly reduce funding for the Advanced Petroleum-Based Fuel program, which was determined to supplant private investments that would otherwise be made to achieve the clean air requirements of EPA's regulation.

DOE has started to use the results of the R&D investment criteria to help analyze its portfolio of investments on the basis of the potential public benefits.

For example, the accompanying "bubble chart" illustrates notionally how programs might be compared on their potential ability to reduce future carbon emissions. The chart compares program benefits (left axis) with the years until the technology is expected to be in the marketplace (bottom axis) and the anticipated budget cost (bubble size, where each bubble represents a different program). This approach would help to analyze whether investments are balanced across time and type of benefits, as well as sensitive to alternative future scenarios (for example, high or low oil prices).

The justification for federal R&D spending is generally greatest where public benefits are the largest, and motivation for private industry to do the research is lowest. For instance, short research horizons in the private sector may postpone or preclude longer-term research with large public benefits.



In this example, two programs (marked "A" and "B") are expected to deliver about the same benefit, but program "A" will likely enter the market first. However, program "A," given its near-term nature, may not need federal support to achieve the benefits and might be better left to the private sector.

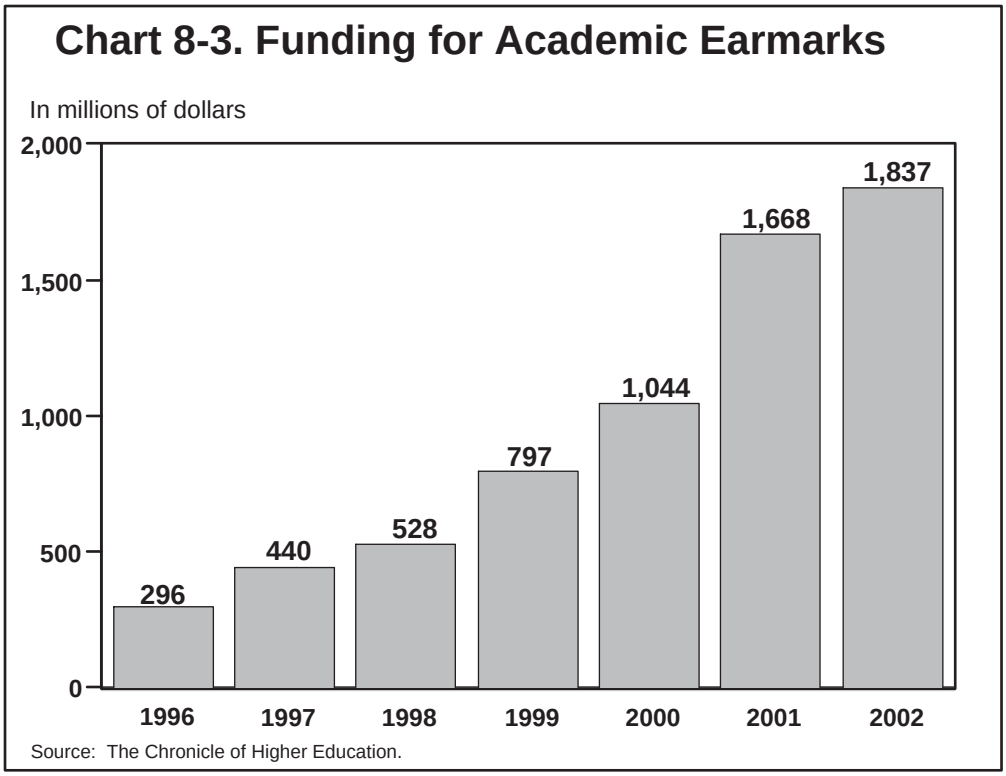
Analyses like this can be used for many aspects of programs, including cost sharing and federal role. For example, the programs labeled "C" in the chart are not expected to deliver significant carbon-emissions reductions, but may score well on some other type of benefit, such as energy-security benefits.

Attempts to analyze such data for the Department's applied R&D programs have illustrated the need for consistent methods of analysis, including ways to present benefits estimates that make comparisons meaningful. DOE is working to improve the consistency and quality of its data.

OMB will continue to work with the R&D agencies and others to integrate the R&D criteria more meaningfully into the budget formulation process in the coming year. Based on lessons learned and other feedback from experts and stakeholders, the Administration will continue to improve the R&D investment criteria and their implementation, towards more effective management of R&D programs and better-informed budget allocation decisions across the R&D agencies.

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 legislative process for use only by a specific organization or project—are counter to a merit-based competitive selection process. The use of earmarks 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 over $1.8 billion in 2002. 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.

Some argue that earmarks help spread the research money to 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. 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.

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, within the Department of Defense (DOD), the Defense Advanced Research Projects Agency seeks out high risk, high payoff scientific proposals, and program managers at the National Science Foundation (NSF) 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, the Congress earmarked DOD's 2003 budget to fund research on a wide range of diseases, including breast cancer, ovarian cancer, prostate cancer, diabetes, leukemia, and polio recovery. Funding at DOD for increases to medical research projects over two-thirds of a billion dollars in this year alone. While research on these diseases is very important, it is generally not unique to the U.S. military and can be better carried out and coordinated within civil medical research agencies, without disruption to the military mission.

The Administration will continue to work with academic organizations, colleges and universities, and the Congress to discourage the practice of research earmarks and to achieve our common objectives.

III. PRIORITIES FOR FEDERAL RESEARCH AND DEVELOPMENT

The 2004 Budget requests record levels for federal R&D ($122.7 billion, a seven-percent increase, as shown in Table 8–2). This request for federal R&D funding is over 60 percent greater than the request of just five years ago. The 2004 Budget includes an emphasis on basic research, increasing basic research funding across the agencies by $1.2 billion (or 5 percent) over the already impressive levels requested for 2003.

In a 1995 report from the National Academy of Sciences, the scientific community proposed a "Federal Science and Technology" (FS&T) budget to highlight the creation of new knowledge and technologies more consistently and accurately than the traditional R&D data collection. Also, because the FS&T budget emphasizes research, funding for defense development, testing, and evaluation is absent. FS&T is readily tracked through the budget and appropriations process, so the effects of budget decisions are clear more immediately. As shown in Table 8–3, the 2004 Budget requests $58.9 billion for FS&T (a two-percent increase over the 2003 request). 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.

Fueling Our Future. Hydrogen-powered fuel cell vehicles have the potential to provide energy diversity, fuel economy, and environmental benefits. Since hydrogen can be manufactured from a number of domestic fossil (natural gas and coal), nuclear, and renewable resources, it offers the potential for eventual "freedom" from the nation's near-exclusive reliance on petroleum for transportation. The budget's FreedomCAR (Cooperative Automotive Research) and FreedomFuel research initiatives will address the difficult technical and cost challenges faced in commercialization of fuel cell vehicles. The budget proposes to spend over $1.5 billion on FreedomCAR and FreedomFuel over the next five years, including more than doubling DOE's spending on hydrogen research and development in 2004. This funding will accelerate achieving the national energy security and environmental benefits from widespread use of hydrogen vehicles.

The President's Budget strengthens the nation's investment in the physical sciences. Research in the physical sciences not only leads to a better understanding of the universe but also spurs progress in a host of areas including microelectronics, information technologies, communications, defense technologies, energy, agriculture, and the environment. Physical sciences research provides education and training opportunities vital for a technologically advanced society. Modern health science uses sophisticated approaches that are increasingly reliant on the physical sciences and associated analytical tools. For instance, the development of magnetic resonance imaging (MRI), among the 20th century's greatest advances in medical diagnosis, depended heavily on advanced concepts from physics. Only with renewed support of research and equipment for fields such as physics, chemistry, and materials science will the nation be able to take full advantage of recent major investments in the health sciences and spur progress in other areas.

To these ends, the 2004 Budget provides NSF with a 13-percent increase in physical science investments. In addition, DOE's Office of Science will almost double its investment in new nanoscale science research centers while maximizing the operation of the Department's existing suite of national scientific user facilities. Two new NASA space telescope programs, the Laser Interferometer Space Antenna (LISA) and Constellation-X, will address fundamental questions about the nature of gravity and high-energy physics in space. The changing nature of science has opened significant opportunities for fundamental discovery at the intersection of physics and astronomy that require the Administration to set priorities and increase interagency coordination. This year, under the auspices of the National Science and Technology Council (NSTC), these and other agencies will work with OSTP to develop a plan for coordination in this area.

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 2004 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 to ensure coordinated strategic planning and implementation. The Administration is in the process of forming new organizations and strengthening interagency coordination for two other priority areas—combating terrorism and climate change R&D. The Administration will continue to analyze other areas of critical need that could benefit in the future from improved focus and coordination among agencies.

Combating Terrorism R&D: The nation's advantage in scientific R&D is being harnessed to help prevent future terrorist activities, minimize our nation's vulnerability to terrorist acts, and respond and recover if an attack should occur. Combating terrorism R&D applications span a wide range, including:

- providing tactical warning and assessment of a biological attack;
- developing gear for first responders;
- enabling the most effective use of the wealth of information collected by the intelligence community;
- developing means to assess the efficacy of proposed protective measures;
- determining the vulnerabilities in the nation's critical infrastructure; and
- preventing the importing of a nuclear weapon or special nuclear material.

Research is focused on areas with the potential to dramatically enhance our capabilities for detecting the presence of, and responding to, nuclear, biological, chemical, radiological, and conventional explosive threats in air, sea, rail, and road transport, both within and beyond our borders. Other priority areas include advances in information technology to identify anomalies that might indicate terrorist intent on the part of individuals or groups of individuals, and the development of better biometric techniques for verifying or determining terrorist identity.

The NSTC's Committee on Homeland and National Security will work with the Office of Homeland Security, the National Security Council, and the new Department of Homeland Security to identify priorities for and facilitate planning among federal departments and agencies involved in homeland or national security R&D. The coordinated federal effort will emphasize: strategies to combat weapons of mass destruction; radiological and nuclear countermeasures; biological agent detection, diagnostics, therapeutics, and forensics; information analysis; social, behavioral, and educational aspects of combating terrorism; border entry/exit technologies; and linkages to other countries' information systems to permit tracking of large-scale health phenomena.

Networking and Information Technology R&D: The budget provides $2.2 billion (a six-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 2004, research emphases 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.

Due to its impact on a wide range of federal agency missions ranging from national security and defense to basic science, high end computing—or supercomputing—capability is becoming increasingly critical. Through the course of 2003, agencies involved in developing or using high end computing will be engaged in planning activities to guide future investments in this area, coordinated through the NSTC. The activities will include the development of an interagency R&D roadmap for high-end computing core technologies, a federal high-end computing capacity and accessibility improvement plan, and a discussion of issues (along with recommendations where applicable) relating to federal procurement of high-end computing systems. The knowledge gained from this process will be used to guide future investments in this area. Research and software to support high end computing will provide a foundation for future federal R&D by improving the effectiveness of core technologies on which next-generation high-end computing systems will rely.

Nanotechnology R&D: The budget provides $792 million for the multi-agency National Nanotechnology Initiative (NNI), a seven-percent increase over 2003. 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; revolutionary advances in energy conversion and storage technologies; and accelerated biotechnical applications in medicine, healthcare, and agriculture. In 2004, the initiative will continue to 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; novel instrumentation for nanoscale measurements;
- nano-biological systems for medical advances and new products;

- innovative nanotechnology solutions for detection of and protection from biological-chemical-radiological-explosive agents;
- the education and training of a new generation of 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.

A recent report of the National Research Council (NRC) underscored the importance of nanoscale science and engineering research and praised the NNI for its role in coordinating interagency nanotechnology funding. In response to the recommendations in the report, an external advisory board will provide advice aimed at strengthening the NNI. The President's Council of Advisors for Science and Technology (PCAST), with expertise relevant to nanotechnology or the management of large-scale, multidisciplinary R&D programs, will conduct this external review. PCAST will be tasked with articulating a strategic plan for the program, defining specific grand challenges to guide the program and identifying metrics for measuring progress toward those grand challenges. PCAST will undertake this effort immediately, and it will advise the federal nanotechnology R&D effort on a continuing basis.

Climate Change R&D: In February 2002 President Bush announced the formation of a new management structure, the Climate Change Science Program (CCSP), to coordinate and oversee ongoing work in the US Global Change Research Program (USGCRP) and the Climate Change Research Initiative (CCRI), launched by the President in June 2001. The CCSP includes participation from 13 federal agencies with a combined budget of approximately $1.7 billion for climate change research.

The CCRI component of the program focuses on reducing significant uncertainties in climate science, improving global climate observing systems, and developing resources to support policymaking and resource management. To meet these goals, the 2004 Budget includes $182 million for government-wide CCRI activities, an increase of $142 million, which support the following three priority areas: (1) key climate change science efforts in ongoing USGCRP activities; (2) climate quality observations, monitoring, and data management; and (3) climate modeling and other tools to inform decision-makers.

The budget also continues significant funding for climate change technology R&D, which is coordinated through the Climate Change Technology Program (CCTP) as part of the President's National Climate Change Technology Initiative (NCCTI). The CCTP is creating an inventory of climate change technology R&D and will recommend priority programs to help meet the President's near-term goal of an 18-percent reduction in energy intensity by 2012, as well as to help address the long-term climate change challenge. One priority program and a key component of the President's initiative is the NCCTI Competitive Solicitation program, which competitively awards funds based on a technology's potential to reduce, avoid, or sequester emissions of greenhouse gases. The budget provides $40 million for this innovative program.

Education R&D: The Administration continues to support research that enables the successful development and implementation of research-based programs and practices called for in the No Child Left Behind Act of 2002, including: (1) comparative trials of preschool curricula, research on developing the English literacy or Spanish speaking students, research on effective mathematics education, and research on social and character development; and, (2) efforts to address fundamental gaps in research knowledge in reading comprehension, cognition and learning in the classroom, teacher quality, knowledge utilization, and proficiency in algebra. This education R&D agenda builds upon the ongoing efforts of the Interagency Education Research Initiative (IERI) being carried out in partnership by the National Science Foundation ($25 million in 2004), the Department of Education ($20 million in 2004), and the National Institute of Child Health and Human Development ($5 million in 2004), as well as the research programs of the individual agencies.

The President's goal of improving the quality of math and science education in Grades K-12 continues to be pursued through the Math and Science Partnerships (MSP) Initiative, which supports school districts to form partnerships with institutions of higher education, allowing scientists and engineers to be part of the solution in improving student math and science achievement. The budget provides $200 million for this initiative at the National Science Foundation and $12.5 million at the Department of Education.

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 programs in selected agencies in the 2004 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): The 2004 Budget provides $27.9 billion for NIH.

- The Administration has demonstrated its strong commitment to biomedical research by completing a five-year doubling of the NIH budget.
- NIH continues to play a key role in addressing pressing health research issues, such as access to state-of-the-art instrumentation and biomedical technologies; development of specialized animal and non-animal research models; and emphasis on "smart" network-connected technologies, computer-aided drug design, gene and molecular ther-

apy development, and bioengineering approaches to decreased health care costs.
- In addition, the NIH budget continues support for biodefense research by providing $1.6 billion for NIH to accelerate clinical trials; target the development of new therapeutic and vaccine products for agents of bioterrorism; and establish regional Centers of Excellence in Biodefense and Emerging Infectious Diseases.

National Aeronautics and Space Administration (NASA): The 2004 Budget provides $9.2 billion for FS&T programs at NASA, a five-percent increase over the 2003 request.
- The 2004 Budget restructures NASA's programs to fit into a new agency vision and mission that emphasize R&D that only NASA can do, which includes reducing or terminating programs that are low priority or are not central to the agency's mission.
- The budget provides $90 million ($2 billion over five years) for the development of the Jupiter Icy Moons Orbiter, the first nuclear-electric space mission. This mission is important in the ongoing search for life beyond Earth, and it will also help prove new power and propulsion technologies for future NASA missions.
- NASA will begin a Human Research Initiative ($37 million), which will provide the research and experience to understand and address health and logistical challenges posed by the hazardous environment of space.
- The budget provides $1.1 billion for investments in future launch systems.
- The budget initiates the next generation of Earth Observing System satellites that are a significant part of the Climate Change Science Program.
- A PART assessment found the Mars Exploration Program to be effective, but the program should improve its long-term measures of program results.

National Science Foundation (NSF): To further promote research and education across the fields of science and engineering, the 2004 Budget provides $5.5 billion for NSF (a nine-percent increase over the 2003 request).
- The budget provides a 13-percent increase (or a $100 million boost) for NSF programs that emphasize the physical sciences, such as awards for individual researchers and centers in physics, chemistry, and astrophysics research. This represents a 35-percent increase ($219 million) over funding levels of five years ago.
- The budget provides: $656 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; and $213 million for climate change research.
- To enhance science infrastructure capabilities, the 2004 Budget continues construction of the international Atacama Large Millimeter Array telescope in Chile, the EarthScope projects for investigating features and processes beneath the North American continent, and IceCube, a South Pole facility for detecting neutrinos.
- The budget provides $200 million for the President's Math and Science Partnership program, to improve the quality of math and science education in Grades K-12. The budget also aims to further attract the most promising U.S. students into graduate level science and engineering by increasing graduate stipends to $30,000 annually, compared with $18,000 in 2001.
- PART assessments were conducted on two NSF programs, Tools and Geosciences, which were found to be effective and moderately effective, respectively.

Department of Energy (DOE): The 2004 Budget provides $5.2 billion for FS&T at DOE, a three-percent increase from 2003.
- DOE will begin a major new initiative to accelerate the worldwide availability and affordability of hydrogen-powered fuel cell vehicles. The new FreedomFuel initiative will focus on research to advance hydrogen production, storage, and infrastructure. It complements the FreedomCAR program announced last year, which is aimed at developing viable hydrogen fuel cell vehicle technology.
- The 2004 Budget provides $3.3 billion for the Office of Science, including funding to ensure its continuing leadership in physical science research and its unique research in genomics, climate change, and supercomputing.
- The budget dedicates $320.5 million to the President's Coal Research Initiative on clean coal technologies, including $62 million for carbon sequestration research on ways to economically dispose of greenhouse gases or otherwise isolate them from the environment.
- DOE will continue its emphasis on R&D to improve energy efficiency and reliability in buildings, industry, and the federal government ($549 million) and on R&D to reduce the cost of renewable energy technologies, such as wind, solar, geothermal, and biomass ($444 million in 2004, a nine-percent increase).
- The budget provides $10 million for Generation IV Nuclear Energy Systems Initiative and $63 million for the Advanced Fuel Cycle Initiative to develop innovative, next-generation nuclear reactor and fuel cycle technologies that are sustainable, proliferation-resistant, and economical.
- This year, DOE assessed all of its major basic science programs using the PART and evaluated 80 individual applied research projects and programs through the R&D investment criteria. The Department will work to improve its measures of

performance and how it estimates the benefits of its R&D.

Department of Defense (DOD): 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 2004 budget includes $5.0 billion that appears in the FS&T budget.

- The 2004 Budget funds "Science and Technology" programs to explore and develop technical options for new defense systems and to avoid being surprised by new technologies in the hands of adversaries. Areas of emphasis include computing and communications, sensors, nanotechnology, and hypersonic propulsion systems. DOD's S&T includes the basic and applied research counted in FS&T, plus advanced technology development.
- The Missile Defense Agency continues to develop technologies for intercepting ballistic missiles in multiple phases of flight. The budget provides funding for missile defense R&D, which includes new efforts for high-speed, boost-phase interceptors, sea-based radars, directed energy technology and advanced battle management systems.
- The Army continues development efforts in support of the Future Combat System as a major part of its transformation to a lighter, more mobile, and more effective fighting force.
- Development continues on the Joint Strike Fighter, the next generation affordable multi-role fighter aircraft, which will use innovative technologies to keep costs low.
- R&D to address terrorist and other unconventional threats continues to be a high priority. Systems and technologies under development to address defense against chemical or biological agents include: improved detectors of chemical and biological threats; troop protective gear for use under chemical and biological attack that is both more effective and more comfortable; and vaccines to protect against biological agents.

Department of Agriculture (USDA): The 2004 Budget provides $1.8 billion, a one-half percent increase, for FS&T at the Department of Agriculture.

- The budget includes increases above the 2003 Budget for in-house research for high priority needs as follows: counter-terrorism and emerging and exotic diseases ($8 million increase), genomics ($8 million increase), and cybersecurity ($2 million increase).
- The 2004 Budget includes $5 million in funding for new priority Forest Service research on biobased products, bioenergy, Sudden Oak Death (SOD), and to accelerate research on rapid management response for invasive species.
- A portion of funding associated with the Plum Island Animal Disease Center (PIADC) is included in the budget for the Department of Homeland Security.

Department of the Interior (DOI): Within the Department of the Interior, the 2004 Budget provides $896 million for the United States Geological Survey (USGS), a three-percent increase.

- The budget provides an increase of $4.1 million to support site specific research to focus eradication efforts against established invasive species, and to initiate development of an invasive species national early detection network.
- An additional $3 million will enhance the ability of scientists, state and local governments, and citizens to integrate and apply geospatial data and remote sensing imagery.
- $200 million for water quality and quantity information includes support for 7,200 streamgages, with data available on the web for 80 percent of the steamgages, and continues study on 42 sites for the National Water Quality Assessment program.
- $5 million will support data integration to inform decisions related to: using water and mineral resources; planning for transportation and utility infrastructure; and reducing the costs of geologic hazards throughout the nation.
- A PART assessment of the National Mapping Program found that the program has a clear purpose and is designed to have a unique impact, but the program is not optimally designed. USGS is working to address these concerns through program evaluation, workforce planning and future business practices.

Department of Commerce (DOC): The 2004 Budget provides $851 million for FS&T at the Department of Commerce.

- For the National Institute of Standards and Technology (NIST), the budget provides $457 million for research and physical improvements at NIST's Measurement and Standards Laboratories. The budget also supports NIST facilities, including equipment for the Advanced Measurement Laboratory in Maryland and renovations of facilities in Boulder, Colorado.
- The 2004 Budget terminates the Advanced Technology Program (ATP), requesting $27 million for administrative and termination costs. ATP is intended to fund the development and dissemination of high-risk technologies through cost-shared grants to companies. The Administration believes that other federal R&D programs have a clearer federal role and are of higher priority. Large shares of ATP funding have gone to major corporations, and projects often have been similar to those being carried out by firms not receiving such subsidies. The Administration previously proposed legislative reforms to ATP to help address these concerns, but these have not been enacted.
- For the National Oceanic and Atmospheric Administration (NOAA) the 2004 Budget provides $367 million, an increase of $76 million (26 percent),

to improve understanding of climate change, weather, air quality, and ocean processes.
- Within this funding level, the budget provides $57 million for the National Sea Grant College Program. The recently passed Sea Grant reauthorization takes initial steps to increase the focus on competition within this program. The Administration will continue to work with NOAA to further increase the percentage of funding awarded through merit-based competition.

Department of Veterans Affairs (VA): The 2004 Budget provides $822 million for FS&T at the Department of Veterans Affairs, an increase of 3.4 percent. In addition, the Department receives significant funding from other governmental agencies and private entities to support VA-conducted research, which brings the total VA R&D to $1.8 billion.
- The 2004 Budget funds 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.

Environmental Protection Agency (EPA): The budget provides $776 million for FS&T for the Environmental Protection Agency to ensure that its efforts to safeguard human health and the environment are based upon the best available scientific and technical information.
- EPA has appointed an Agency Science Advisor to improve environmental science integration and coordination at EPA.
- The President's Budget provides $6.5 million to improve the validity of existing and proposed chemical testing programs through computational toxicology research, which integrates modern computing with advances in genomics to develop alternatives to traditional animal testing approaches.
- In support of the President's Management Agenda, the Agency will use the R&D Investment Criteria to improve R&D program management and effectiveness and demonstrate performance.
- EPA will continue to improve its risk assessment capabilities, methodologies, and management.

Department of Transportation (DOT): The 2004 Budget provides $606 million for FS&T at the Department of Transportation, an increase of 11 percent.
- The Federal Highway Administration ($404 million in 2004) supports research, technology, and education to improve the quality and safety of the nation's transportation infrastructure, such as increasing the quality and longevity of roadways, identifying safety improvements, and promoting congestion mitigation through the use of Intelligent Transportation Systems.
- The budget of the National Highway Traffic Safety Administration provides $95 million (an increase from 2003 of $14 million) for R&D in crash worthiness, crash avoidance, and data analysis to help reduce highway fatalities and injuries. The budget also includes funding for a crash causation survey.
- In 2004, R&D at the Federal Motor Carrier Safety Administration focuses on issues including driver safety performance, commercial vehicle safety performance, carrier compliance and safety, and other studies toward the goal of achieving a substantial reduction in crashes and fatalities.
- The 2004 Budget provides $100 million for the Federal Aviation Administration to maintain its focus on safety and environmental research to develop the most effective technologies to prevent aviation-related accidents and reduce noise pollution.
- The Transportation Security Administration and the Coast Guard, which have each contributed to DOT's R&D portfolio in the past, have been transferred to DHS.

Department of Education: The 2004 Budget provides $373 million for FS&T at the Department of Education, a decrease of $68 million from the 2003 request.
- The President fulfills his promise to reform education research with the recent creation of the Institute of Education Sciences (IES), through the Education Sciences Reform Act.
- Within IES, the 2004 research portfolio of the National Center for Education Research will support comparative trials of curricula in preschool, mathematics, and English instruction for language minority students, as well as continuing efforts to study reading comprehension and cognition as it relates to student learning.
- The National Institute for Disability and Rehabilitation Research (NIDRR) ($110 million in 2004) conducts research, demonstration projects and training, and related activities that increase the opportunities for people with disabilities to lead independent lives. Consistent with the President's New Freedom Initiative, NIDRR's activities enhance community integration and employment outcomes. In 2004, NIDRR will continue priority research in areas such as accessibility of telecommunications systems and mental illness.
- The Office of Special Education Programs (OSEP) supports special education research projects, demonstrations, and outreach to provide new knowledge in the field of special education and early intervention, and to translate scientifically valid information into applied educational strategies. These activities promote improved education outcomes for students with disabilities. In 2004, OSEP is planning new research in areas such as teacher quality, assessment and accountability.

Department of Homeland Security (DHS): While funding for the new Department of Homeland Security is not currently included in the FS&T budget, the 2004 Budget requests $1.0 billion for DHS R&D.

- The Department will house a Science and Technology (S&T) Directorate, which will assess the Department's long-term needs, help develop a policy and strategic plan for identifying priorities and goals and will support the conduct of R&D for developing countermeasures to chemical, biological, radiological and nuclear weapons and other terrorist threats. The 2004 request for direct activities of the S&T Directorate is $803 million.
- DHS will harness the expertise, energy and ingenuity of the private sector, academia, and government labs to develop and produce advanced technologies, systems, and procedures needed for homeland security.
- The creation of DHS consolidates a large share of homeland-security related R&D into one agency, which will ensure consistent strategic direction; DHS will coordinate with other agencies to avoid wasteful duplication. For example, the Department will carefully plan and coordinate R&D to increase the effectiveness of threat detection, destruction, and mitigation activities, and provide new related capabilities where none existed previously.

Stimulating Private Investment

Along with direct spending on R&D, the federal government has sought to stimulate private R&D investment through tax preferences. 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 nearly $23 billion over the period from 2004 to 2008, and $68 billion through 2013. 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)

	2004	2005	2006	2007	2008	2004–2008
Current Law	4,990	2,910	1,240	520	170	9,830
Proposed Extension	1,005	3,278	5,187	6,291	7,129	22,890
Total	**5,995**	**6,188**	**6,427**	**6,811**	**7,299**	**32,720**

IV. FEDERAL R&D DATA

Federal R&D Funding

R&D is the collection of efforts directed towards gaining fuller 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 or understanding, directed 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)

	2002 Estimate	2003 Proposed	2004 Proposed	Dollar Change: 2003 to 2004	Percent Change: 2003 to 2004
By Agency					
Defense	49,409	57,498	62,753	5,255	9%
Health and Human Services	23,497	27,466	28,031	565	2%
National Aeronautics and Space Administration	9,611	10,071	11,009	938	9%
Energy	8,056	8,076	8,535	459	6%
National Science Foundation	3,557	3,692	4,062	370	10%
Agriculture	2,112	1,911	1,943	32	2%
Veterans Affairs	1,126	1,188	1,232	44	4%
Commerce	1,376	1,304	1,190	–114	–9%
Homeland Security	266	761	1,001	240	32%
Transportation	774	627	693	66	11%
Interior	623	575	633	58	10%
Environmental Protection Agency	416	627	556	–71	–11%
Other	1,206	1,206	1,100	–106	–9%
Total	**102,029**	**115,002**	**122,738**	**7,736**	**7%**
Basic Research					
Defense	1,334	1,417	1,309	–108	–8%
Health and Human Services	13,000	14,304	14,983	679	5%
National Aeronautics and Space Administration	1,911	2,268	2,535	267	12%
Energy	2,536	2,522	2,571	49	2%
National Science Foundation	3,090	3,228	3,505	277	9%
Agriculture	797	823	819	–4	0%
Veterans Affairs	465	509	495	–14	–3%
Commerce	362	359	412	53	15%
Homeland Security	32	47	47	0	0%
Transportation	17	16	37	21	131%
Interior	41	39	38	–1	–3%
Environmental Protection Agency	63	100	101	1	1%
Other	201	213	218	5	2%
Subtotal	**23,849**	**25,845**	**27,070**	**1,225**	**5%**
Applied Research.					
Defense	4,081	4,289	3,670	–619	–14%
Health and Human Services	10,038	12,152	12,820	668	5%
National Aeronautics and Space Administration	2,810	3,101	2,947	–154	–5%
Energy	2,458	2,538	2,901	363	14%
National Science Foundation	185	199	204	5	3%
Agriculture	875	821	847	26	3%
Veterans Affairs	638	653	712	59	9%
Commerce	715	660	592	–68	–10%
Homeland Security	78	64	126	62	97%
Transportation	502	376	411	35	9%
Interior	522	481	537	56	12%
Environmental Protection Agency	262	355	356	1	0%
Other	610	645	661	16	2%
Subtotal	**23,774**	**26,334**	**26,784**	**450**	**2%**
Development					
Defense	43,775	51,677	57,625	5,948	12%
Health and Human Services	104	139	124	–15	–11%
National Aeronautics and Space Administration	2,588	2,630	3,061	431	16%
Energy	1,990	2,007	2,088	81	4%
National Science Foundation	0	0	0	0	N/A
Agriculture	132	134	137	3	2%
Veterans Affairs	23	26	25	–1	–4%
Commerce	145	78	43	–35	–45%
Homeland Security	93	537	663	126	23%
Transportation	244	216	226	10	5%
Interior	60	55	58	3	5%
Environmental Protection Agency	91	172	99	–73	–42%

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

(Budget authority, dollar amounts in millions)

	2002 Estimate	2003 Proposed	2004 Proposed	Dollar Change: 2003 to 2004	Percent Change: 2003 to 2004
Other	379	334	214	–120	–36%
Subtotal	**49,624**	**58,005**	**64,363**	**6,358**	**11%**
Facilities and Equipment					
Defense	219	115	149	34	30%
Health and Human Services	355	871	104	–767	–88%
National Aeronautics and Space Administration	2,302	2,072	2,466	394	19%
Energy	1,072	1,009	975	–34	–3%
National Science Foundation	282	265	353	88	33%
Agriculture	308	133	140	7	5%
Veterans Affairs	0	0	0	0	N/A
Commerce	154	207	143	–64	–31%
Homeland Security	63	113	165	52	N/A
Transportation	11	19	19	0	0%
Interior	0	0	0	0	N/A
Environmental Protection Agency	0	0	0	0	N/A
Other	16	14	7	–7	–50%
Subtotal	**4,782**	**4,818**	**4,521**	**–297**	**–6%**

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. The FS&T budget highlights the creation of new knowledge and technologies more consistently and accurately than the traditional R&D data collection. Also, because the FS&T budget emphasizes research, funding for defense development, testing, and evaluation is absent. FS&T is readily tracked through the budget and appropriations process, so the effects of budget decisions are clearer more immediately.

Table 8–3. FEDERAL SCIENCE AND TECHNOLOGY BUDGET

(Budget authority, dollar amounts in millions)

	2002 Estimate	2003 Proposed	2004 Proposed	Dollar Change: 2003 to 2004	Percent Change: 2003 to 2004
By Agency					
National Institutes of Health	**23,279**	**27,344**	**27,893**	**549**	**2%**
NASA	**7,868**	**8,701**	**9,164**	**463**	**5%**
Space Science	2,902	3,414	4,007	593	17%
Earth Science	1,592	1,628	1,552	–76	–5%
Biological & Physical Research	824	842	973	131	16%
Aeronautics Technology [1]	997	947	959	12	1%
Crosscutting Technologies [1]	1,553	1,869	1,673	–196	–11%
National Science Foundation	**4,823**	**5,028**	**5,481**	**453**	**9%**
Energy [2]	**5,194**	**5,065**	**5,211**	**146**	**3%**
Science Programs	3,232	3,256	3,311	55	2%
Renewable Energy	385	407	444	37	9%
Nuclear Energy [3]	362	327	388	61	19%
Energy Conservation [4]	631	596	549	–47	–8%
Fossil Energy [5]	583	479	519	40	8%
Defense	**5,415**	**5,706**	**4,979**	**–727**	**–13%**
Basic Research	1,334	1,417	1,309	–108	–8%
Applied Research	4,081	4,289	3,670	–619	–14%
Agriculture	**1,862**	**1,834**	**1,843**	**9**	**0%**
CSREES Research & Education [6]	551	560	526	–34	–6%
Economic Research Service	67	73	77	4	N/A
Agricultural Research Service [7]	1,003	958	987	29	3%
Forest Service [8]	241	243	253	10	4%
Interior (USGS)	**914**	**867**	**896**	**29**	**3%**
Commerce	**926**	**841**	**851**	**10**	**1%**
NOAA (Oceanic & Atmospheric Research) [9]	356	291	367	76	26%
NIST [10]	570	550	484	–66	–12%
Veterans Affairs [11]	**756**	**794**	**822**	**28**	**4%**
Environmental Protection Agency [12]	**788**	**825**	**776**	**–49**	**–6%**
Transportation	**693**	**548**	**606**	**58**	**11%**

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

(Budget authority, dollar amounts in millions)

	2002 Estimate	2003 Proposed	2004 Proposed	Dollar Change: 2003 to 2004	Percent Change: 2003 to 2004
Highway research [13]	448	421	506	85	20%
Aviation research [14]	245	127	100	–27	–21%
Education	**310**	**363**	**373**	**10**	**3%**
Special Education Research and Innovation	78	78	78	0	0%
NIDRR [15]	110	110	110	0	0%
Research, Development, and Dissemination [16]	122	175	185	10	6%
Total	**52,828**	**57,916**	**58,894**	**978**	**2%**

[1] Aeronautics Technology and Crosscutting Technologies replace what had been listed as Aerospace Technology.
[2] All years reflect levels before transfer of funds to Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.
[3] All years reflect transfer of oversight responsibility for the Idaho National Engineering and Environmental Laboratory.
[4] Excludes weatherization and state grant programs.
[5] Enacted and requested levels exclude balances transferred from the Clean Coal Technology program: $34 million in 2002 and $40 million in 2003.
[6] Excludes receipts for Native American Endowment, $7 million in 2002, and $7 million in 2003, and $9 million in 2004.
[7] Excludes buildings and facilities. Excludes portion of Plum Island Animal Disease Center, now included in DHS.
[8] Forest and Rangeland Research.
[9] The 2003 level does not include the Sea Grant program.
[10] Excludes Manufacturing Extension Program.
[11] Medical Research.
[12] Science and Technology plus superfund transfer. Includes combating-terrorism supplemental funding, primarily for drinking water vulnerability assessments. The 2003 superfund transfer includes funding for building decontamination research.
[13] Includes R&D funding for the Federal Highway Administration, the Federal Motor Carrier Safety Administration, and the National Highway Traffic Safety Administration.
[14] Federal Aviation Administration Research, Engineering, and Development. Starting with 2003 request, excludes funding for aviation security research, now funded through DHS's Transportation Security Administration.
[15] National Institute on Disability and Rehabilitation Research.
[16] Does not include funding for Regional Educational Labs.

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 Science Program.

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

(Budget authority, dollar amounts in millions)

	2002 Estimate	2003 Proposed	2004 Proposed	Dollar Change: 2003 to 2004	Percent Change: 2003 to 2004
Networking and Information Technology R&D					
National Science Foundation	662	678	724	46	7%
Defense	439	442	461	19	4%
Health and Human Services [1]	347	374	441	67	18%
Energy	306	310	317	7	2%
NASA	181	213	195	-18	-8%
Commerce	36	38	39	1	3%
Environmental Protection Agency	2	2	2	0	0%
Total	**1,973**	**2,057**	**2,179**	**122**	**6%**
National Nanotechnology Initiative					
National Science Foundation	204	221	247	26	12%
Energy	89	133	197	64	48%
Defense	180	202	176	-26	-13%
National Institutes of Health	59	65	70	5	8%
Commerce (NIST)	77	78	53	-25	-32%
NASA	35	33	31	-2	-6%
Agriculture	0	1	10	9	900%
Environmental Protection Agency	6	6	5	-1	-17%
Homeland Security (TSA) [2]	2	2	2	0	0%
Justice	1	1	1	0	0%
Total	**653**	**742**	**792**	**50**	**7%**
Climate Change Science Program					
NASA	1,090	1,112	1,068	-44	-4%
National Science Foundation	189	203	213	10	5%
Commerce (NOAA)	100	118	136	18	15%
Energy	117	129	133	4	3%
Agriculture	55	66	73	7	11%
National Institutes of Health	56	59	61	2	3%
Interior (USGS)	26	26	26	0	0%
Environmental Protection Agency	21	22	22	0	0%

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

(Budget authority, dollar amounts in millions)

	2002 Estimate	2003 Proposed	2004 Proposed	Dollar Change: 2003 to 2004	Percent Change: 2003 to 2004
Smithsonian	6	6	6	0	0%
U.S. Agency for International Development	6	6	6	0	0%
Transportation	0	0	4	4	N/A
State	0	0	1	1	N/A
Total	**1,666**	**1,747**	**1,749**	**2**	**0%**
Subtotal, CCRI (included in CCSP total)	**0**	**40**	**182**	**142**	**355%**

[1] Includes funds from offsetting collections for the Agency for Healthcare Research and Quality: $21 million in 2002, $15 million in 2003, and $55 million in 2004.

[2] Activities of the Transportation Security Administration, formerly within DOT.

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 to address an emergency).

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, 2002 and 2003

(Percent of Agency Research)

	Research Performed at Congressional Direction*		Inherently Unique Research		Merit-Reviewed Research with Limited Competitive Selection		Merit-Reviewed Research, Competitive Selection and Internal Evaluation		Merit-Reviewed Research, Competitive Selection and External Evaluation	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
By Agency.										
Health and Human Services	1%	N/A	1%	1%	18%	17%	1%	1%	80%	81%
Defense	10%	N/A	8%	8%	19%	21%	60%	67%	3%	3%
National Aeronautics and Space Administration	6%	N/A	3%	1%	5%	6%	39%	37%	46%	55%
Energy	5%	N/A	21%	21%	51%	55%	7%	7%	16%	17%
National Science Foundation	0%	N/A	0%	0%	5%	5%	7%	6%	88%	89%
Agriculture	4%	N/A	50%	51%	36%	39%	0%	0%	9%	10%
Veterans Affairs	0%	N/A	0%	0%	0%	0%	33%	33%	67%	67%
Commerce	4%	N/A	42%	49%	15%	15%	22%	22%	17%	14%
Interior	7%	N/A	33%	32%	34%	39%	24%	27%	2%	2%
Environmental Protection Agency	5%	N/A	7%	9%	54%	45%	15%	15%	19%	31%
Transportation	16%	N/A	14%	24%	0%	0%	69%	76%	0%	0%
Education	0%	N/A	0%	0%	0%	0%	0%	0%	100%	100%
Homeland Security	15%	N/A	5%	41%	75%	55%	5%	4%	0%	0%
Smithsonian Institution	0%	N/A	100%	100%	0%	0%	0%	0%	0%	0%
Other	81%	N/A	1%	7%	3%	15%	14%	72%	1%	5%
Percent of Agency Research	**4%**	**N/A**	**7%**	**7%**	**20%**	**20%**	**15%**	**15%**	**54%**	**58%**
Research Funding (dollars in millions)	**1,977**	**N/A**	**3,553**	**3,548**	**9,313**	**10,235**	**7,064**	**7,541**	**25,717**	**29,772**

*2003 levels for this category are generally not available yet, so percentages shown for 2003 have been modified to add to 100 percent without this category.