14. GENERAL SCIENCE, SPACE, AND TECHNOLOGY

Table 14–1. FEDERAL RESOURCES IN SUPPORT OF GENERAL SCIENCE, SPACE, AND TECHNOLOGY
(In millions of dollars)

Function 250	1997 Actual	Estimate					
		1998	1999	2000	2001	2002	2003
Spending:							
Discretionary Budget Authority	16,641	17,914	18,459	18,479	18,735	18,977	19,091
Mandatory Outlays:							
Existing law	25	40	37	37	34	31	31
Tax Expenditures:							
Existing law	1,075	2,555	1,440	1,055	905	820	795
Proposed legislation	....	365	802	608	261	124	49

Science and technology are the principal agents of change and progress, with over half of the Nation's economic productivity in the last 50 years attributable to technological innovation and the science that supported it. Appropriately enough, the private sector makes many investments in technology development. The Federal Government, however, also has a role to play—particularly when risks are too great or the return to companies is too small.

Within this function, the Federal Government supports areas of science at the cutting edge, through the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Department of Energy (DOE) science programs. The activities of these agencies contribute to greater understanding of the world we live in, ranging from the edges of the universe to the smallest imaginable particles, and to new knowledge that may or may not have immediate applications to improving our lives. Because the results of basic research are unknowable in advance, the challenge of developing performance goals for this area is formidable.

Each of these agencies has a tradition of funding high-quality research and contributing to the Nation's cadre of skilled scientists and engineers. To continue this tradition, and as a general goal for activities under this function, at least 80 percent of the research projects[1] will be reviewed by appropriate peers and selected through a merit-based competitive process.

An important Federal role in this area is to construct and operate major scientific facilities and capital assets for multiple users. These include telescopes, satellites, oceanographic ships, and particle accelerators. Many of today's fast-paced advances in medicine and other fields rely on these facilities.

As general goals:

- Agencies will keep the development and upgrade of these facilities on schedule and within budget, not to exceed 110 percent of estimates.
- In operating the facilities, agencies will keep the operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled possible operating time, on average.

[1] Measured by the amount of funds allocated, not the number of projects.

The budget proposes $18.5 billion to conduct these activities. The Government also seeks to stimulate private investment in these activities through over $2 billion a year in tax credits and other preferences for research and development (R&D).

National Aeronautics and Space Administration

The budget proposes $12.3 billion for NASA activities in this function. While NASA's funding represents just 12 percent of total Federal funds for R&D, NASA serves as the lead Federal agency for R&D in civil space activities, working to expand frontiers in air and space to serve America and improve the quality of life on Earth. NASA pursues this vision through balanced investment in space science, Earth science, space transportation technology, and human exploration and development of space.

The 1999 goals for these enterprises follow.

Space Science programs, for which the budget proposes $2.1 billion, are designed to enhance our understanding of how the universe was created, the formation of planets, and the possible existence of life beyond Earth. NASA has enjoyed major successes of late, including the landing on Mars with Mars Pathfinder.

- NASA space science will successfully launch its four planned spacecraft missions—Mars 98 lander, Stardust, and two Explorer missions—within 10 percent of its schedule and budget.
- NASA space science will increase its contribution to the general knowledge base and to education, as reflected by its contributions to a college space science textbook, to a level at least equal to the 1996 level of 27 percent.
- The NASA Advisory Council will rate all near-term space science objectives as being met or on schedule. Examples of objectives include: investigate the composition, evolution and resources of Mars, the Moon, and small solar system bodies such as asteroids and comets; identify planets around other stars; and observe the evolution of galaxies and the intergalactic medium.

Earth Science programs, for which the budget proposes $1.4 billion, focus on increasing our understanding of the total Earth system and the effects of natural and human-induced changes on the global environment through long-term, space-based observation of Earth's land, oceans, and atmospheric processes. NASA will launch the first in a new series of Earth Science spacecraft in 1998.

- NASA Earth Science will successfully launch its four planned spacecraft missions—Quikscat, the Advanced Land Imager, a Geostationary Operational Environmental Satellite, and the Shuttle Radar Topography mission—within 10 percent of its schedule and budget.
- NASA will obtain new data on precipitation, land surface, and climate, and will deliver the data to users within five days.
- NASA's Advisory Council will rate all near-term earth science objectives as being met or on schedule. Examples of objectives include: observe and document land cover and land use change and impacts on sustained resource productivity; and understand the causes and impacts of long-term climate variations on global and regional scales.

Space Transportation Technology programs, for which the budget proposes $400 million, work with the private sector to develop and test experimental launch vehicles that cut the cost of access to space.

- The X-33 program will begin flight tests in 1999 and demonstrate, by year-end, key technologies to cut the cost of space transportation. These technologies will be directly scaleable to the mass fraction (less than 10 percent empty vehicle weight) required for future reusable launch vehicles and meet the following operational requirements: flights faster than Mach 13; 48-hour and seven-day ground turnarounds; and 50-person maintenance crews.
- The X-34 program will perform 25 flight tests in one year, starting no later than March 1999, to demonstrate the operational parameters of future reusable launch vehicles. These parameters include:

recurring costs under $500,000; 24-hour ground turnarounds; safe abort landings; landings in cross winds up to 20 knots; and flights through rain and fog.

Human Exploration and Development of Space (HEDS) programs, for which the budget proposes $5.8 billion, focus on human space exploration. In 1997, HEDS programs supported the successful launch of eight Space Shuttle flights, a continuous U.S. presence on the Russian Mir space station, and continued construction of the International Space Station. In 1998, assembly of the International Space Station will begin in Earth orbit.

For 1999, the performance goals include the following:

- NASA will successfully complete Phase 2 (the first ten assembly flights) of the International Space Station within performance, schedule, and budget targets.
- NASA will ensure that space shuttle safety, reliability and cost will improve, by achieving seven or fewer flight anomalies per mission, successful on-time launches 85 percent of the time, and a 13-month flight manifest preparation time.
- NASA will expand human presence and scientific resources in space by increasing the amount of crew time in orbit to 185 weeks.
- NASA-supported scientific research in life and microgravity sciences will broaden, as indicated by a rise in the number of resulting journal publications to 1,600.

National Science Foundation

NSF-supported activities have led to breakthroughs and advances in many areas, including superconducting materials, Doppler radar, the Internet and World Wide Web, medical imaging systems, computer-assisted-design, genetics, polymers, plate tectonics, and global climate change. While NSF represents just three percent of Federal R&D spending, it supports nearly half of the non-medical basic research conducted at academic institutions. NSF also provides 30 percent of Federal support for mathematics and science education. NSF programs involve over 25,000 senior scientists; 50,000 other professionals, graduate students, and undergraduate students; and 120,000 K-12 teachers.

The budget proposes $3.7 billion in 1999 for NSF, which it would invest in four key program functions:

Research Project Support: Over half of NSF's resources support research projects performed by individuals and small groups, instrumentation, and centers.

- An independent assessment will judge NSF's portfolio of research programs to have the highest scientific quality and an appropriate balance of projects characterized as high-risk, multidisciplinary, or innovative.
- NSF will ensure that all of its new announcements of research opportunities and proposal solicitations will contain an explicit statement encouraging proposers to integrate their research activities with improving education or public understanding of science.
- NSF will increase the percentage of competitive awards going to new investigators to at least 30 percent, a 2.6-percent rise over a baseline of 27.4 percent.

Facilities: Facilities such as observatories, particle accelerators, research stations, and oceanographic research vessels provide the platforms for research in fields such as astronomy, physics, and oceanography. About 20 percent of NSF's budget supports large, multi-user facilities required for cutting-edge research. NSF facilities will meet the function-wide goals to remain within cost and schedule, and to operate efficiently.

Education and Training: Education and training activities, accounting for 20 percent of NSF's budget, revolve around efforts to improve teaching and learning in science, mathematics, engineering, and technology at all education levels. Education and training projects develop curriculum, enhance teacher training, and provide educational opportunities for students from pre-K through undergraduate degrees. NSF also contributes to the education of future scientists and engineers by supporting graduate students and postdoctoral programs.

- Over 80 percent of schools participating in a systemic initiative program will: 1) implement a standards-based curriculum in science and mathematics; 2) further professional development of the instructional workforce; and 3) improve student achievement on a selected battery of tests, after three years of NSF support.
- NSF will fund intensive professional development experiences for at least 75,000 precollege teachers.

Administration and Management: NSF does not operate programs or laboratories; rather, the agency supports research and education activities, conducted primarily at colleges and universities, selected through a competitive, merit-based process.

Performance goals for 1999 include:

- processing 70 percent of grant proposals within six months of receipt, and
- publishing 95 percent of program announcements at least three months before proposals are due.

Department of Energy

DOE provides major scientific user facilities and sponsors basic scientific research in specific fields, such as high energy and nuclear physics and materials, chemical, biological, and environmental sciences. It supports over 60 percent of federally-funded research in the physical sciences.

The budget proposes $2.5 billion for DOE science programs, which include high energy and nuclear physics, basic energy sciences, biological and environmental research, and computational technology research. These programs support scientific facilities for high energy and nuclear physics, and also support the research performed by the users of the facilities. They also provide and operate synchrotron light sources, neutron sources, supercomputers, high-speed networks, and other instruments that researchers use in fields ranging from biomedicine to agriculture, geoscience, materials, and physics. These state-of-the-art scientific facilities provide the cutting edge experimental and theoretical techniques that provide insights into dozens of applications, and they are available, on a competitive basis, to researchers funded by NSF, other Federal agencies, and public and private entities. DOE's facilities will meet the function-wide goals to remain within cost and schedule, and to operate efficiently.

The 1999 goals for these programs follow.

Basic Energy Sciences (BES) supports basic research in the natural sciences for new and improved energy techniques and technologies, and to understand and mitigate the environmental impacts of energy technologies.

- BES will start construction of the Spallation Neutron Source to provide beams of neutrons used to probe and understand the physical, chemical, and biological properties of materials at an atomic level—leading to better fibers, plastics, catalysts, and magnets and improvements in pharmaceuticals, computing equipment, and electric motors.
- An independent assessment will judge BES research programs to have high scientific quality.

Computational Technology Research (CTR) performs long-term computational, technology, and advanced energy projects research through an integrated program in applied mathematical sciences, high performance computing and communications, information infrastructure, advanced energy projects research, and laboratory technology research.

- CTR will complete prototype development of the "virtual lab" approach and implement at least three program trial applications.
- Users will judge that computer facilities and networks have met 75 percent of their requirements.

Biological and Environmental Research (BER) provides fundamental science to develop the knowledge to identify, understand, and anticipate the long-term health and environmental consequences of energy production, development, and use.

- BER will complete sequencing of 40 million subunits of human DNA to submit to publicly accessible databases.

- BER will complete 70 percent of the genetic sequencing of over 10 additional microbes with significant potential for waste cleanup and energy production.

High Energy and Nuclear Physics (HENP) strives to deepen understanding of the nature of matter and energy at the most fundamental level, as well as understanding of the structure and interactions of atomic nuclei.

- An independent assessment will judge HENP research programs to have high scientific quality.
- HENP will begin operating the B-factory at the Stanford Linear Accelerator Center, the Main Injector for the Tevatron at Fermilab, and the Relativistic Heavy Ion Collider at Brookhaven National Laboratory, and will deliver on the 1999 U.S./DOE commitments to the international Large Hadron Collider project. These facilities will provide cutting-edge scientific capabilities to further study the fundamental constituents of matter. For example, the B-factory will illuminate the basic question of why matter exists in the universe.

Tax Incentives

Along with direct spending on R&D, the Federal Government has sought to stimulate private investment in these activities with tax preferences. The law provides a 20-percent tax credit for private research and experimentation expenditures above a certain base amount. The credit, which was extended in 1997, is due to expire on June 30, 1998. The President proposes to extend it for one year—that is, through June 1999. Under current law, the credit will cost $2.1 billion in 1998 and $860 million in 1999.

A permanent tax provision also lets companies deduct, up front, the costs of certain kinds of research and experimentation, rather than capitalize these costs; this tax expenditure will cost $580 million in 1999. Finally, equipment used for research benefits from relatively rapid cost recovery; the cost of this tax preference is calculated in the tax expenditure estimate for accelerated depreciation of machinery and equipment.