15. GENERAL SCIENCE, SPACE, AND TECHNOLOGY

Table 15–1. FEDERAL RESOURCES IN SUPPORT OF GENERAL SCIENCE, SPACE, AND TECHNOLOGY

(In millions of dollars)

Function 250	1998 Actual	Estimate					
		1999	2000	2001	2002	2003	2004
Spending:							
Discretionary Budget Authority	17,950	18,775	19,202	19,408	19,372	19,339	19,335
Mandatory Outlays:							
Existing law	44	72	78	68	34	34	34
Tax Expenditures:							
Existing law	2,385	1,985	1,490	1,035	855	795	765
Proposed legislation	.....	311	933	656	281	133	53

Science and technology are principal agents of change and progress, with over half of the Nation's economic productivity growth 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 plays a role—particularly when risks are too great or the potential return for companies is too long-term.

Within this function, the Federal Government supports areas of cutting-edge science, through the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Department of Energy (DOE). The activities of these agencies contribute to greater understanding of the world in which we live, 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 unpredictable, the challenge of developing performance goals for this area is formidable.

Each of these agencies funds high-quality research and contributes 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 will be reviewed by appropriate peers and selected through a merit-based competitive process.

Another important Federal role 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.

The budget proposes $19.2 billion to conduct these activities. The Government also stimulates private investment in these activities through over $1 billion a year in tax credits

and other preferences for research and development (R&D).

National Aeronautics and Space Administration

The budget proposes $12.5 billion for NASA activities in this function. NASA serves as the lead Federal agency for research and development 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 four enterprises: Space Science; Earth Science; Space Transportation Technology; and Human Exploration and Development of Space.

Space Science programs, for which the budget proposes $2.2 billion, are designed to enhance our understanding of how the universe was created, how stars and planets evolve and die, and the possible existence of life beyond Earth. In the past year, NASA spacecraft achieved several important watershed events in Space Science including the first direct image of a planet outside the solar system, taken by the Hubble Space Telescope, and a confirmed discovery of ice on the moon by the Lunar Prospector mission.

- NASA Space Science will successfully launch its three planned spacecraft—the Thermosphere, Ionosphere, and Mesosphere Energetics and Dynamics mission; the Imager for Magnetopause-to-Aurora Global Exploration, and the High Energy Solar Spectroscopic Imager—within 10 percent of their schedules and budgets.
- NASA Space Science will develop innovative new technologies to reduce the cost of future spacecraft by delivering the first engineering model of a standard, miniaturized integrated avionics system, to be used for the Europa Orbiter and future missions.
- 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 $1.5 billion, focus 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. This year, NASA's Tropical Rainfall Measuring Mission provided new insights that will enable weather forecasters to more accurately predict where and when a hurricane will hit land.

- NASA Earth Science will successfully launch its three planned spacecraft—the Advanced Cavity Radiometer Irradiance Monitor, the Vegetation Canopy Lidar (VCL) mission, and a technology validation mission to reduce the costs of future Landsat missions—within 10 percent of their schedules and budgets.
- NASA Earth Science will double the volume of precipitation, land surface, and climate data it archives from its missions compared to 1998, increase the number of products delivered from its archives by 10 percent, and make the data available 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 $240 million, work with the private sector to develop and test experimental launch vehicles that reduce the cost of access to space.

- The X–33 program will begin flight testing in 2000 to demonstrate technologies that are traceable to the mass fraction and operability required for future reusable launch vehicles (including 48-hour surge turnarounds and seven day routine turnarounds with a 50-person ground crew).
- The X–34 program will continue flight testing in 2000 to demonstrate tech-

nologies key to the operational requirements of future reusable launch vehicles including high flight rates (including a flight rate of 25 flights in one year).

Human Exploration and Development of Space (HEDS) programs, for which the budget proposes $5.6 billion, focus on the use of human skills and expertise in space. In 1998, HEDS programs supported the successful launch of four Space Shuttle flights, including one flight to better understand the functioning of the nervous system in the environment of space. In November, 1998, assembly of the International Space Station in orbit began with the joining of the first Russian and American modules.

- On the International Space Station, NASA will deploy the U.S. Laboratory Module, initiate Station-based extra-vehicular activity capability, and activate a Station-based external robotic manipulator within performance, schedule and budget targets.
- NASA will ensure that Space Shuttle safety, reliability, availability and cost will improve, by achieving seven or fewer flight anomalies per mission, successful on-time launches 85 percent of the time, and a 12-month flight manifest preparation time.
- NASA will expand human presence and scientific resources in space by initiating continuous three-person crew presence on the International Space Station.

National Science Foundation

The budget proposes $3.9 billion in 2000 for NSF. 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, and 30 percent of Federal support for mathematics and science education. In 1998, NSF investments, in conjunction with NIH, led to the discovery that biological clocks are not just in the brain, but in genes, thereby prompting the consideration of new strategies for the treatment of disorders associated with jet lag, shift work, and seasonal depression. In addition, NSF-funded scientists determined that the years 1997, 1995, and 1990 were the warmest since 1400 A.D., providing further evidence of the importance of human influence on the global climate system.

NSF research and education investments are made in three primary areas:

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

- An independent assessment will judge whether NSF's research investments have lead to important discoveries and new knowledge and techniques, both expected and unexpected, within and across traditional disciplinary boundaries. The assessment will also determine connections between discoveries and their service to society.
- NSF will maintain the percentage of competitive research grants going to new investigators at a minimum of 30 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 19 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 postdoctoral.

- 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.

Department of Energy

DOE provides major scientific user facilities and sponsors basic scientific research in specific fields supporting over 60 percent of federally-funded research in the physical sciences.

The budget proposes $2.8 billion for DOE science programs, which include high-energy and nuclear physics, basic energy sciences, biological and environmental research, fusion energy sciences, and computational and technology research. These programs support scientific facilities for high-energy and nuclear physics and fusion energy sciences and 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, and materials. These facilities provide the cutting-edge experimental and theoretical techniques to enable 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. Regular peer-review assessments will judge whether DOE science programs have high scientific quality.

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 continue construction of the Spallation Neutron Source, at cost and timetables as contained in the Critical Decision II agreement, to provide beams of neutrons used to probe and understand the properties of materials at an atomic level. This research leads to better fibers, plastics, catalysts, and magnets and improvements in pharmaceuticals, computing equipment, and electric motors.

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

- CTR will develop advanced computing capabilities, computational algorithms, models, methods, and libraries, and advanced visualization and data management systems to enable new computing applications in science.

- 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 50 million subunits of human DNA and provide these to publicly accessible databases.

- BER will commence full operation at three Atmospheric Radiation Measurement sites to provide unique climatological data.

High Energy and Nuclear Physics (HENP) strives to deepen the 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.

HENP will deliver on the 2000 U.S./DOE commitments to the international Large Hadron Collider project. HENP facilities will provide cutting-edge scientific capabilities to further study the fundamental constituents of matter.

Fusion Energy Sciences (FES) conducts research on the scientific and technical basis for an economical and environmentally acceptable fusion energy source.

- FES will operate the National Spherical Torus Experiment and three small, innovative experiments to provide a basic scientific understanding of fusion concepts.

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 current law provides a 20-percent tax credit for private research and experimentation expenditures above a certain base amount. The credit, which was extended in 1998, is due to expire on June 30, 1999. The President proposes to extend it for one year. Under current law, the credit will cost $1.7 billion in 1999 and $1.0 billion in 2000. The extension will cost $0.3 billion in 1999 and $0.9 billion in 2000.

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 $510 million in 2000. 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.