10. PROMOTING SCIENCE AND TECHNOLOGY

American history clearly demonstrates the importance of American leadership in science and technology to the future of our Nation. Investments in science and technology drive economic growth, generate new knowledge, create new jobs, build new industries, ensure sustained national security, and improve our quality of life.

President Clinton
November 1995

Technological innovation has accounted for at least half of the Nation's productivity growth in the last 50 years. We enjoy the fruits of this innovation every day in the many technologies we have come to depend on for our way of life, including lasers, computers, x-rays, teflon, weather and communication satellites, jet aircraft, microwave ovens, solar-electric cells, and human insulin. The development of these technologies has created new industries and millions of high-skilled, high-wage American jobs. Thus, technology has become a major engine of economic growth, a significant contributor to our national security, a generator of new knowledge, and a critical tool in protecting our health and environment.

Because our investments in science and technology (S&T) have paid such rich dividends, sustaining U.S. leadership in S&T is a cornerstone of the President's vision for America. The budget maintains vital investments in S&T by adding funds for basic research in health sciences at the National Institutes of Health, for basic research and education at the National Science Foundation, for research at other agencies that depend on S&T for their missions, and for cooperative projects with industry and universities.

As the President has said, we need to balance the budget in a way that boosts economic growth and encourages public and private investment in innovative S&T. This budget continues the record of S&T investment and economic stimulation that has helped to keep the economy strong over the last three years.

The Federal Role in S&T

The post-Cold War era is one of intense global economic competition. Our country also faces new national security challenges, including threats from environmental degradation, emerging infectious diseases, the proliferation of nuclear and biological weapons, and regional conflicts.

Thus, the Federal Government has an indispensable role to play in investing in S&T—a role critical to the country's economy, national security, environment, health, and other social needs. This is especially true when the risk is too great for individual companies to make the needed investment, or when the public benefit is large but private return is small. Our Nation also must support a balanced mix of S&T investments (i.e., basic research, applied research, and technology development), since the steps involved in technological innovation are so profoundly interwoven.

The Administration has initiated or expanded public-private partnerships to spur innovations with broad economic impact. These partnerships have traditionally served our Nation well, not only in building transportation infrastructure (e.g., highways, airways, harbors, and railroads), but in nurturing new types of technological infrastructure (e.g., information highways, global positioning satellites, and environmental monitoring sys-

tems). The partnerships enable the private sector to translate new knowledge into novel technologies that benefit its bottom line and society at large.

Science and Technology Highlights

Under the 1996 budget resolution, Congress would cut support to S&T programs by about 30 percent by the year 2002.[1] At a time when increased global competition threatens U.S. markets, and when Japan has proposed doubling its investments in S&T, the President believes we cannot afford such deep cuts. In his budget negotiations with the bipartisan congressional leadership, the President has repeatedly reaffirmed his commitment to economic prosperity, education, health, the environment, and national security. S&T investments are critical to these goals. The budget fulfills his commitments by:

Increasing Total Funding for Science and Technology: This budget marks the fourth straight year that the President has proposed increases in S&T investments. Table 10–1 shows the proposal to invest roughly $73 billion in research and development (R&D), over $1 billion more than in 1996.[2] In keeping with previous efforts, the budget also provides an increasing share for civilian R&D investments, with those investments at 47 percent of the total. Table 10–2 lists selected S&T highlights.

Boosting Funding for Basic Research and Health Research: The budget proposes $14 billion for basic research, a $278 million increase over 1996, including a four percent increase for the National Science Foundation. Given the importance of basic and applied health science research, the budget boosts funding at the National Institutes of Health by four percent.

Strengthening University-based Research: University-based research is key to America's future; simultaneously, it provides new knowledge and new technology, and it trains the next generation of scientists and engineers. The budget proposes $13 billion for university-based research, an increase of $155 million over 1996. It also proposes $22 billion for merit-reviewed research (six percent more than in 1996), which comprises 31 percent of the R&D budget.

Investing in Innovation to Create New Jobs and Industries: Under this Administration, many of the new jobs have been high-tech, high-wage jobs in industries like biotechnology and computing—jobs that didn't exist a decade or two ago. The budget maintains a strong investment in technology to foster these high-priority civilian S&T industries and jobs. Funding continues or expands for high-performance computing research; for the Advanced Technology Program, which works with industry to develop high-risk, high-payoff technologies; for a Manufacturing Extension Program to help small business battle foreign competition by adopting modern technologies and production techniques; and for other programs.

Increasing Environmental Research: S&T investments are critical for enhancing environmental quality. While we are making progress on many pollution fronts, emerging global environmental problems pose new risks. The budget maintains vital research to provide safe food, clean air, and pure water. It supports research into new environmental technologies to provide better environmental protection at lower cost, while generating jobs and exports. It supports programs to increase energy efficiency and the development of renewable energy sources that cut demand for foreign oil, and partnerships with industry to develop cars that use less fuel. The budget invests in programs that preserve biological diversity and help us understand and prepare for changing climate conditions and natural disasters. These investments also provide a sound scientific basis for rational rule-making on, and the cost-effective implementation of, environmental regulations. (For more details, see Chapter 9.)

[1] American Association for the Advancement of Science, 1995.

[2] Research and development (R&D) is a widely-accepted measure of investment in S&T.

Table 10–1. RESEARCH AND DEVELOPMENT INVESTMENTS

(Budget authority, dollar amounts in millions)

	1993 Actual	1995 Actual	1996 Estimate [1]	1997 Proposed	Dollar Change: 1996 to 1997	Percent Change: 1996 to 1997
By Agency:						
Defense	38,898	35,350	35,428	35,523	+95	+*%
Health and Human Services	10,472	11,519	12,118	12,621	+503	+4%
National Aeronautics and Space Administration	8,873	9,390	9,334	9,359	+25	+*%
Energy	6,896	6,481	6,689	6,269	–420	–6%
National Science Foundation	2,012	2,431	2,430	2,516	+86	+4%
Agriculture	1,467	1,542	1,479	1,499	+20	+1%
Commerce	793	1,164	1,086	1,260	+174	+16%
Interior	649	668	622	582	–40	–6%
Transportation	613	667	622	679	+57	+9%
EPA	511	554	508	585	+77	+15%
Other	1,308	1,315	1,134	[2] 1,786	+652	+57%
Total	**72,492**	**71,081**	**71,450**	**72,679**	**+1,229**	**+2%**
By R&D Theme:						
Basic research	13,362	13,805	14,059	14,337	+278	+2%
Applied research	13,608	14,273	14,251	14,862	+611	+4%
Development	42,795	41,118	41,238	41,042	–196	–*%
Equipment	.....	743	701	696	–5	–1%
Facilities	2,727	1,142	1,201	1,742	+541	+45%
Total	**72,492**	**71,081**	**71,450**	**72,679**	**+1,229**	**+2%**
By Civilian Theme:						
Basic research	11,951	12,629	12,940	13,181	+241	+2%
Applied research	9,130	10,566	10,560	11,135	+575	+5%
Development	7,269	8,488	8,297	8,096	–201	–2%
Equipment	.....	599	554	546	–8	–1%
Facilities	1,979	975	996	1,446	+450	+45%
Subtotal	30,329	33,257	33,347	34,404	+1,057	+3%
By Defense Theme:						
Basic research	1,411	1,176	1,119	1,156	+37	+3%
Applied research	4,478	3,707	3,691	3,727	+36	+1%
Development	35,526	32,316	32,612	32,615	+3	+*%
Equipment	.....	458	476	481	+5	+1%
Facilities	748	167	205	296	+91	+44%
Subtotal	42,163	37,824	38,103	38,275	+172	+*%
By R&D Share:						
Defense	42,163	37,824	38,103	38,275	+172	+*%
Civilian	30,329	33,257	33,347	34,404	+1,057	+3%
Total	**72,492**	**71,081**	**71,450**	**72,679**	**+1,229**	**+2%**
Percent civilian	42%	47%	47%	47%	NA	NA
R&D support to universities	11,674	12,445	12,573	12,728	+155	+1%
Merit (peer) reviewed R&D programs	.....	21,895	21,160	22,406	+1,246	+6%

NA = Not applicable.

* Less than $500 thousand or 0.5 percent.

[1] Includes Administration's proposed adjustments to 1996 continuing resolution levels.

[2] Includes total funding for several projects as part of a Government-wide transition to upfront funding of fixed assets.

Table 10–2. SELECTED SCIENCE AND TECHNOLOGY HIGHLIGHTS

(Budget authority, dollar amounts in millions)

	1993 Actual	1995 Actual	1996 Estimate [1]	1997 Proposed	Dollar Change: 1996 to 1997	Percent Change: 1996 to 1997
National Science Foundation	2,734	3,229	3,220	3,325	+105	+3%
National Institutes of Health	10,325	11,240	11,939	12,406	+467	+4%
Environmental Protection Agency:						
Environmental technology initiative	.....	72	72	72	+*	+*%
Science to achieve results	.....	48	95	115	+20	+21%
National Aeronautics and Space Administration:						
International space station	2,262	2,113	2,144	2,149	+5	+*%
Mission to Planet Earth	917	1,344	1,289	1,402	+113	+9%
New millennium initiative	67	436	569	549	–20	–4%
Reusable launch vehicle technology program	0	129	159	266	+107	+67%
Aeronautics inititiative	129	347	415	442	+27	+7%
Department of Energy:						
Stockpile stewardship	1,799	1,520	1,567	1,648	+81	+5%
Science users facilities initiative	.....	.....	100	100	+*	+*
Energy efficiency and pollution preventions R&D	350	447	417	548	+131	+31%
Renewable energy R&D	257	363	275	363	+88	+32%
Fusion energy science program	340	361	244	264	+20	+8%
Department of Commerce:						
NIST—Advanced technology program	68	341	300	345	+45	+15%
NIST—Manufacturing extension partners	18	74	100	105	+5	+5%
NIST—Intramural research	193	247	259	271	+12	+5%
NOAA—Weather service modernization	474	576	604	742	+138	+23%
NTIA—National information infrastructure	.....	42	54	59	+5	+9%
Department of Defense dual use application program	.....	.....	.....	250	+250	+*
USDA national research initiative	98	101	97	130	+33	+34%
Department of Transportation intelligent transportation system	155	217	208	337	+129	+62%
National Science and Technology Council initiatives:						
High performance computing and communications: [2]						
Defense	298	375	315	337	+22	+7%
Health and Human Services	47	68	81	87	+6	+7%
National Aeronautics and Space Administration	82	131	116	104	–12	–10%
Energy	100	119	121	125	+4	+3%
National Science Foundation	233	297	291	280	–11	–4%
Commerce	12	30	31	34	+3	+10%
Environmental Protection Agency	.....	12	12	6	–6	–48%
Transportation	.....	24	23	43	+20	+87%
Education	.....	16	12	18	+6	+50%
Veterans	.....	24	21	16	–5	–24%
Subtotal	772	1,096	1,023	1,050	+28	+3%
U.S. global change research program: [3]						
Health and Human Services	1	4	4	4	+*	+*
National Aeronautics and Space Administration	917	1,308	1,250	1,375	+125	+10%
Energy	118	119	111	112	+2	+1%
National Science Foundation	124	169	163	170	+7	+4%
Agriculture	55	60	56	59	+3	+5%
Commerce	66	57	60	69	+9	+15%
Interior	38	30	29	29	+*	+*
Transportation	.....	6	6	7	+1	+17%
Environmental Protection Agency	.....	23	25	19	–6	–24%
Smithsonian	.....	7	7	7	+*	+*
Tennesse Valley Authority	.....	2	1	1	+*	+*
Subtotal	1,319	1,785	1,712	1,852	+141	+8%
Environment and natural resources	.....	5,365	5,186	5,448	+262	+5%
Partnership for a new generation of vehicles	.....	223	241	288	+47	+20%
Construction and building	.....	168	162	194	+32	+20%
Educational technology	.....	464	397	434	+37	+9%

*Less than $500 thousand or 0.5 percent.

[1] Includes Administration's proposed adjustments to 1996 continuing resolution levels.

[2] Listing by agency required by law.

[3] Listing by agency required by law, subset of Environment and Natural Resources.

Investing in a 21st-Century Education: Information technology has revolutionized America's businesses, but largely bypassed its classrooms. We must use this new technology to help children prepare for the challenges of the 21st Century. Building on the experience of earlier Federal investment in educational technology, the President is proposing a new Technology Literacy Challenge Fund to encourage States and communities, working with private sector partners, to develop and implement plans for adopting these technologies. (For more details, see Chapter 8.)

Enhancing Programs to Keep Our Nation Secure: While the budget continues investments in defense research that ensure our strong, future military capabilities, it also fosters key programs to: keep nuclear weapons out of the hands of terrorists; achieve a Comprehensive Test Ban Treaty by using science-based techniques to ensure the safety and reliability of our nuclear weapons stockpiles; and bolster strong international S&T cooperation to improve global stability. The budget also supports the Dual Use Applications program, which puts the technical know-how and economies of scale from commercial industry at the service of national defense.

Agency Highlights

National Science Foundation (NSF): The NSF promotes science in service to society, primarily by awarding competitively-selected grants for research and education. Because most NSF awards go to our Nation's colleges and universities, they serve to both produce knowledge and train the next generation of scientists and engineers. The budget proposes $3.3 billion for NSF, a more than three percent increase over 1996. Included are funds to address critical health, safety, and environmental impact issues at the Amundsen-Scott Station at the South Pole.

National Institutes of Health (NIH): The budget continues the Administration's commitment to biomedical and behavioral research, which promotes the health and well-being of all Americans. The proposed $12.4 billion for NIH is a $467 million, or four percent, increase over 1996. NIH's highest priority continues to be funding investigator-initiated, peer-reviewed research project grants. The budget includes increases for HIV/AIDS-related research, research into breast cancer and other health concerns of women, minority health initiatives, high performance computing, prevention research, gene therapy, and developmental and reproductive biology. The budget also includes funding for a new NIH Clinical Research Center, which would give NIH a state-of-the-art research facility in which scientists would bring their latest discoveries from the laboratory bench to the patient's bedside.

Environmental Protection Agency (EPA):

Environmental Technology Initiative (ETI): The ETI is a partnership among government, industry, non-governmental organizations, and communities to protect public health and prevent pollution by promoting innovative environmental technologies, both in the United States and abroad. ETI supports regulatory reinvention efforts by allowing companies and communities to comply with environmental regulations by using the most cost-effective technology strategies possible. The budget proposes $72 million for ETI, and a total of $127 million for all of EPA's environmental technology efforts.

Science to Achieve Results (STAR) Program: The budget proposes $115 million (21 percent more than in 1996) for the STAR program, which awards grants on the basis of rigorous peer review by extramural researchers. Under the program, EPA cooperates with NSF and the Energy Department to sponsor joint requests for grant applications.

National Aeronautics and Space Administration (NASA):

International Space Station: The Administration proposes continued funding of the International Space Station at $2.1 billion. In less than two years, NASA will launch the first segments of this ambitious undertaking among the United States, Europe, Japan, Canada, and Russia. NASA and the Russian Space Agency have reconfirmed their commitments to the program and have conducted precursor research on two Space Shuttle flights to the Russian MIR space station, with another seven planned through 1998.

Mission to Planet Earth (MTPE): MTPE is NASA's effort to observe, understand, and predict natural and human-induced changes

to the environment. The budget proposes $1.4 billion for MTPE, nine percent more than in 1996. MTPE programs include the Earth Observing System satellites and information system, the Landsat satellite, and a broad range of scientific research and data analysis activities. NASA is also exploring new ways to obtain environmental data using very small spacecraft and purchasing data sets from industry.

New Millennium Initiative (NMI): The NMI represents a fundamentally new way for NASA to develop and operate robotic space missions. The initiative has transformed space missions from occasional, decade-long, multi-billion dollar undertakings to more frequent, cheaper, and exciting projects that have reinvigorated a broad section of the space science community. The budget proposes $549 million to support over 25 missions, either in orbit or under development.

Reusable Launch Vehicle (RLV) Technology Program: The RLV technology program develops technology designed to significantly cut the cost of getting into space. The budget proposes $266 million in preparation for a 1996 decision whether to proceed with the X–33, an experimental flight vehicle whose costs would be shared with industry.

Aeronautics Initiative: The budget proposes $442 million for NASA aeronautics initiatives, a seven percent increase over 1996. These initiatives are partnerships with industry and include advanced subsonic technology and high speed research that may revolutionize the next generation of airplanes.

Department of Energy (DOE):

Stockpile Stewardship: The President's commitment to a Comprehensive Test Ban Treaty (CTBT) is closely linked to the Administration's plan to maintain the safety and reliability of the nuclear weapons stockpile through scientific experiments and computer modeling (i.e., no explosive testing of nuclear weapons). The budget proposes $1.6 billion for these efforts in 1997, a five percent increase over 1996, reflecting the President's commitment to provide sufficient funding for this program next year and over the next decade. Closely linked to this program, the President also is committed to funding a comprehensive R&D program over the next decade to improve treaty monitoring capabilities and operations. President Clinton hopes to complete and sign the CTBT in 1996.

Science User Facilities Initiative: The budget proposes continuing this $100 million initiative begun in 1996 to supplement the operations and capabilities of DOE's major basic research facilities. The 1996 funding has generated an increase in hours of operation ranging from 20 to 100 percent at various DOE facilities; additional staff support for the university, government, and industry researchers; and upgraded and expanded instrumentation.

Energy Efficiency and Pollution Prevention R&D: The budget proposes increases for research on technologies that use natural gas and electricity more efficiently; new manufacturing processes that offer higher productivity as well as lower energy and environmental costs; and innovative transportation and energy conversion processes. The budget proposes $548 million, $131 million more than in 1996.

Renewable Energy R&D: The budget proposes $363 million, $88 million over 1996, for research and technical assistance to foster world-class competitive renewable electricity and fuels industries, including solar thermal and photovoltaic, wind and geothermal power, transportation fuels, and energy from biomass crops and wastes. The development of alternative energy sources represents a critical environmental and economic issue for the next century.

Fusion Energy Sciences Program: DOE continues to support basic research and experimentation in plasma and fusion sciences, with the long-term goal of harnessing fusion as a viable energy source. The budget proposes $264 million, roughly an eight percent increase over 1996, and provides for increased basic research activities, the investigation of tokamak alternatives, and continued operation of the three major U.S. experimental machines. The budget proposes continued U.S. participation in the design of the International Thermonuclear Experimental Reactor.

Department of Commerce (DOC):

National Institute of Standards and Technology (NIST): NIST promotes U.S. economic growth by working with industry to develop and apply technology, measurements, and standards. NIST employs a unique combination of innovative programs. The Advanced Technology Program (ATP) is a rigorously competitive, industry-led, and cost-shared R&D program that fosters technology development, promotes industrial alliances, and creates jobs. The budget proposes $345 million for ATP to support roughly $120 million in new awards and continue commitments to over 500 companies. The Manufacturing Extension Partnership (MEP) provides the Nation's 381,000 smaller manufacturers with technological information and expertise that could improve their operations. The budget proposes $105 million for MEP to support 75 extension centers nationwide. The budget proposes $271 million for NIST laboratories to support important measurement research with industry in areas such as semiconductor metrology, advanced materials, and biotechnology. The budget also proposes $105 million for technology facilities, $80 million of which to construct a new Advanced Technology Laboratory to support cutting-edge research.

National Oceanic and Atmospheric Administration (NOAA) National Weather Service Modernization: The largest modernization in the National Weather Service's history is well underway. The budget requests $742 million to support this multi-year effort to develop and deploy cutting-edge technology, including advanced radar equipment, other ground observing systems, and geostationary and polar-orbiting satellites that will greatly improve the timeliness and accuracy of severe weather and flood warnings.

National Telecommunications and Information Administration (NTIA) National Information Infrastructure (NII) Grants Program: The budget requests $59 million in grants to help develop the NII, which provides the infrastructure that enables computers to connect to one another and to information systems across the country. These grants help fund demonstration projects to show how information technology can improve the delivery of educational, health, and other social services.

Department of Defense (DOD) Dual Use Applications Program: The budget includes $250 million for the Dual Use Applications Program (DUAP). DOD would solicit projects as Government-industry partnerships, and select those that meet military needs. The DUAP is built around a three-year process of transition from technology concept to product demonstration. This new program builds on the Technology Reinvestment Project (TRP), a highly successful experiment that proved DOD could acquire superior commercial technologies for military needs through cost sharing, Government-industry partnerships.

Department of Agriculture (USDA) National Research Initiative: The budget proposes $130 million for the National Research Initiative (NRI), a 34 percent increase over 1996, to support research on a broad range of topics, including integrated pest management, biological control of pests and diseases, human nutrition, plant genome, water quality, food safety, sustainable agriculture, and agricultural systems. NRI is unique in USDA's research portfolio because its awards are based on merit review evaluations by scientific peers.

Department of Transportation Intelligent Transportation System (ITS) Initiative: The budget includes $337 million for the ITS initiative, an increase of 62 percent over 1996. Under ITS, the Administration would work with 75 of the Nation's largest and most congested metropolitan areas to develop and deploy modern information technology for highway and transit systems.

National Science and Technology Council Interagency Initiatives

High Performance Computing and Communications (HPCC): The budget proposes $1 billion, a three percent increase over 1996, for research and development in information and communications technologies that build on HPCC's accomplishments over the past five years.

Environment and Natural Resources: The budget proposes $5.4 billion, a five percent increase over 1996, for research to address environmental issues ranging from local to regional to global, including: air quality, biodiversity and ecosystems, global change, natural disaster reduction, resource use and management, toxic substances/hazardous and solid waste, and water resources/coastal and marine environments. The budget includes $1.9 billion for the U.S. Global Change Research Program, eight percent more than in 1996.

Partnership for a New Generation of Vehicles: The budget proposes $288 million, a $47 million increase over 1996, for research to: 1) develop advanced manufacturing techniques that make it easier to get new automobiles and auto components into the marketplace quickly; 2) use new technologies for near-term improvements in auto efficiency, safety, and emissions; and 3) lead to production prototypes of vehicles that are three times more fuel efficient than today's cars, with no sacrifice in comfort, performance, or price.

Construction and Building: The budget proposes $194 million, a 20 percent increase over 1996, for research to develop better construction technologies to improve the competitive performance of U.S. industry, raise the life cycle performance of buildings, and protect public safety and the environment.

Educational Technology: The budget proposes $434 million, or a nine percent increase over 1996, for research and development on education and training to improve learning in schools, workplaces, and homes. (See, for instance, "Investing in a 21st-Century Education," earlier in this chapter.)