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ABSTRACT

This report presents data compiled as a part of a comprehensive program to measure and analyze the nation's resources expended for research and development. In fiscal year 1977, Federal R&D obligations are expected to total $23.5 billion, a record high and an increase of 8.6% over 1976. This upward shift occurs despite the fact that more than one-half of the R&D functional areas reflect declines or only nominal increases. Of the 15 functions that categorize Federal R&D programs in 1977, four reflect significant increases: energy development and conversion - up 24%; education - up 15%; science and technology base - up 14%; and national defense - up 13%. The largest dollar decrease - $100 million - is scheduled for health, and the next - $19 million - is represented by crime prevention and control. Data are graphed to show R&D funding trends for 1969, 1976 (est.) and 1977 (est.), and for the period 1969-1977 R&D functions are tabulated by function. (Author/MH)

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Real Increases Seen for Federal R&D Funding of Energy, Education, Science, and Defense in FY 1977

Data discussed below are taken from a forthcoming report, An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1977. *The 15 functional categories were chosen to make visible the chief objectives reflected by R&D programs in the 1977 budget. Data are additive to 100 percent, and thus each program can appear only under the function that embraces its primary purpose and not under functions that relate to secondary purposes.*

In fiscal year 1977 Federal R&D obligations are expected to total $23.5 billion, a record high and an increase of 8.6 percent over 1976. This upward shift occurs despite the fact that more than one-half of the R&D functional areas reflect declines or only nominal increases. Strong gains in a few areas account for the overall rise.

Of the 15 functions that categorize Federal R&D programs in 1977 four reflect significant increases: energy development and conversion—up 24 percent; education—up 15 percent; science and technology base—up 14 percent; and national defense—up 13 percent. In these areas growth is well ahead of anticipated inflation.

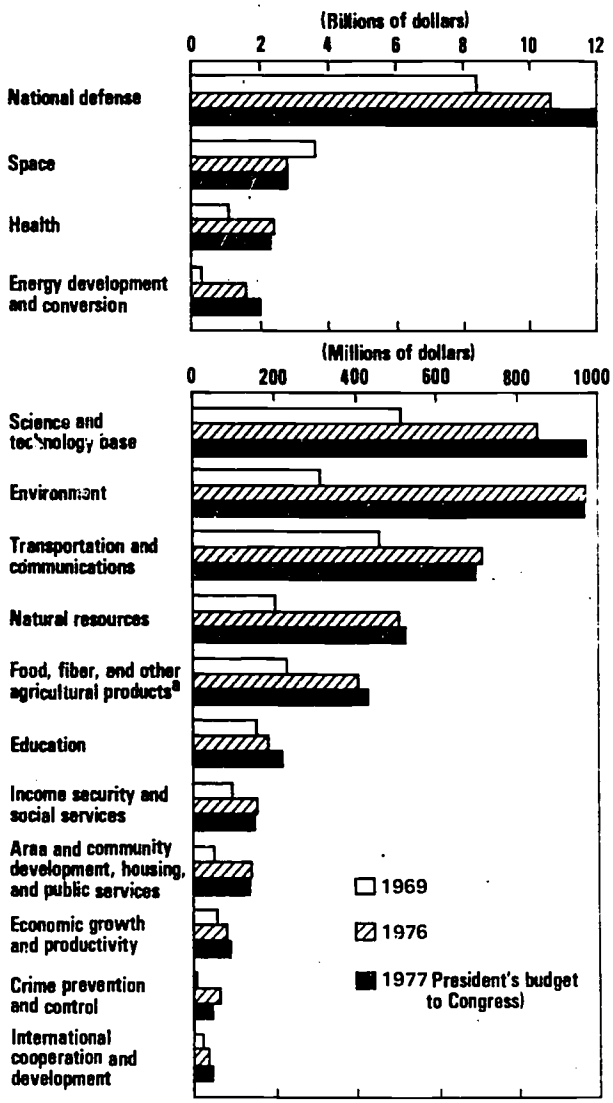
Two other areas should also show real, though smaller, growth in 1977. These are international cooperation and development—up 8 percent; and food, fiber, and other agricultural products—up 7 percent.[1]

The nine remaining functional areas are expected either to decline in terms of real growth or to show an absolute decline in support.

The largest dollar increase is indicated by national defense; R&D programs here are scheduled to grow by $1,346 million over 1976. Next largest dollar gain is shown by energy—up $390 million over 1976. Science and technology base is expected to grow by $120 million, and space, by $62 million. The education function shows an increase of $29 million.

The largest dollar *decrease*—$100 million—is scheduled for health, 4 percent below the 1976 level. The next—$19 million—is represented by crime prevention and control, 31 percent below the previous year. Dollar decreases for other functions are of minor import.

FEDERAL R&D OBLIGATIONS BY FUNCTION, FY 1969, 1976 (est.) and 1977 (est.)



[1] Food, fiber, and other agricultural products is a new function category in the projected report. Most programs under this activity were shown in earlier reports within natural resources under a food subfunction.

[a] Most programs under this function category were formerly shown within natural resources under a food subfunction.

SOURCE: National Science Foundation

Prepared in the Government Studies Group, Division of Science Resources Studies

Long-term Changes

Over the longer term, 1969 to 1977, a number of larger functional areas have grown far more rapidly than the 5.2 percent average annual growth rate shown by overall Federal R&D obligations. The energy function has grown five times as fast as the Federal R&D total, environment, three times and national resources, more than two times. Two smaller functions in size of support have also grown rapidly; these are area and community development, with an average annual growth rate more than double that of the Federal R&D total, and crime prevention and control, with a growth rate six times as high.

The three leading functions are not among this faster growing group. National defense, in first place throughout the entire 1969-77 period, shows an average annual growth rate of 4.6 percent in the 8-year timespan. The comparable figure for health, the third largest function, is 9.1 percent. Space, the second largest function throughout the whole period, reflects a long-term rate of decline of 2.9 percent, the only function with such a history.

Federal R&D obligations by function:[1] Average annual percent change in selected periods

Function	1969-75	1975-76	1976-77
Total	3.3	13.5	8.6
National defense	2.4	10.6	12.6
Space	-6.4	14.6	2.1
Health	11.6	8.7	-4.2
Energy development and conversion	23.0	47.0	23.9
Science and technology base	7.2	9.7	14.0
Environment	17.7	16.4	-.1
Transportation and communications	3.7	11.1	-1.2
Natural resources	13.9	14.9	3.4
Food, fiber, and other agricultural products[2]	7.6	15.4	6.6
Education	.7	16.8	15.3
Income security and social services	7.7	2.4	-1.6
Area and community development, housing, and public services	17.0	8.0	-.4
Economic growth and productivity	2.2	24.2	3.7
Crime prevention and control	46.0	37.8	-30.5
International cooperation and development	1.7	15.5	7.7

[1] Listed in descending order of 1977 obligations.
[2] Most programs under this function category were formerly shown within natural resources under a food subfunction.
Source: National Science Foundation.

R&D Programs by Function

• The requested 1977 increase for **national defense** is far higher than any increase shown in earlier years. This function, however, is expected to represent 51 percent of the Federal R&D total in 1977 compared with 53 percent in 1969.

Missiles and related equipment has been the leading program area since 1973. The 10-percent increase for this subfunction in 1977 brings the dollar level to $2.5 billion. Missile programs showing greatest emphasis are the Navy sea-launched cruise missile and fleet ballistic missile system. Work on the CSEDS test site for the Aegis shipboard weapon system will increase significantly. The Trident submarine-launched missile system is still the major naval R&D program, but funding is considerably reduced. Growing Army programs include the U.S. Roland short-range air defense system, the cannon-launched guided projectile (CLGP), and the Pershing II nuclear strike missile. The Air Force will stress work on advanced ICBM technology and the air-launched cruise missile.

Other equipment is scheduled for a 13-percent increase in 1977, to a total of $2.4 billion. This area includes such expanding programs as the Air Force E-4, advanced airborne command post.

Aircraft and related equipment is scheduled for growth of 16 percent in 1977—to a $2.3 billion level. The major programs to influence this rise are the Navy F-18 fighter aircraft and LAMPS helicopter, the Army AAH advanced attack helicopter, and the Air Force F-16 air combat fighter and EF-111A electronic warfare subsystem. Continued development is planned for the B-1 bomber but at a lower level than in 1976.

Programwide management and support of the Department of Defense (DOD) is expected to cross the $1 billion mark in 1977.

Defense-related atomic energy is scheduled for very slight overall growth since an increase in weapons research and development and testing on the part of the Energy Research and Development Administration (ERDA) is partially offset by a decline in funding for ERDA naval reactor development.

Ordnance, combat vehicles, and related equipment reflects a 35-percent increase in support in 1977.

Ships, small craft, and related equipment will grow an estimated 21 percent.

Military astronautics and related equipment changes very little in level of support in 1977 while *military sciences* reflects a 16-percent increase.

• The **space** function reveals yearly decreases in funding from 1969 to 1974 and yearly increases from 1974 onward. The estimate for 1977, however, is still considerably lower than the 1969 level, and the share of space in the Federal R&D total is an expected 13 percent, compared with 24 percent in the earlier year.

The leading subfunction has always been *manned space flight*, and in the current period the predominant program is the NASA space shuttle on which development will continue for all major components. In 1977 the space shuttle accounts for more than two-fifths of all space activities. *Space sciences*, almost one-fifth of the space total in 1977, reflects a decline from 1976, the result of lower funding for NASA lunar and planetary exploration as the Viking and Outer Planet missions move into the launch stage. *Space technology*, covering balanced activity by NASA in the research and technology disciplines, will increase in 1977, as will NASA *supporting space activities*.

• The **health** function showed steady growth from 1970 through 1976, but a drop occurs between 1976 and 1977 in all four subfunctions. Despite the decrease, the share of health in the Federal R&D total is an estimated 10 percent in 1977, compared with 7 percent in 1969.

More than 9 out of 10 health R&D dollars are devoted

Federal R&D obligations by function:[1] fiscal years 1969-77

[Dollars in millions]

Function	1969	1970	1971	1972	1973	1974	1975	Estimated 1976	Estimated 1977
Total	$15,641	$15,340	$15,564	$16,512	$16,821	$17,438	$19,044	$21,625	$23,488
nal defense	8,354	7,976	8,106	8,898	8,998	8,974	9,621	10,641	11,987
	3,732	3,510	2,893	2,714	2,601	2,478	2,511	2,879	2,940
	1,127	1,126	1,340	1,590	1,626	2,098	2,178	2,368	2,269
Energy development and conversion[2]	328	317	324	383	442	605	1,110	1,632	2,021
Science and technology base	513	525	524	601	604	694	781	857	977
Environment	315	354	465	533	652	693	837	975	974
Transportation and communications	458	590	779	615	630	703	641	711	702
Natural resources	201	238	325	354	341	340	429	504	521
Food, fiber, and other agricultural products[3]	225	241	247	291	297	291	349	402	429
Education	155	147	186	191	214	173	161	188	237
Income security and social services	97	106	132	129	162	137	151	154	171
Area and community development, housing, and public services	49	91	100	101	118	120	127	137	136
Economic growth and productivity	56	79	93	58	68	68	63	79	82
Crime prevention and control	5	9	10	25	35	36	46	63	44
International cooperation and development	27	32	32	29	32	27	30	34	37

[1] R&D plant excluded.

[2] The inclusion of R&D plant obligations for energy would add $276 million in 1975, $302 million in 1976, and $487 million in 1977.

[3] Most programs under this function category were formerly shown within natural resources under a food subfunction.

Note: Detail may not add to totals because of rounding.

Source: National Science Foundation.

to *biomedical research* in the current (1975-77) period. This subfunction encompasses the R&D activities of the National Institutes of Health (NIH) of the Department of Health, Education, and Welfare (HEW), the medical and prosthetic research of the Veterans Administration (VA), the research of HEW's Center for Disease Control (CDC), and the drugs and devices research of HEW's Food and Drug Administration (FDA). Over the longer term greatest growth has been shown in cancer, heart and lung, child health and human development, dental, and environmental health research. The decreases shown for several NIH institutes in 1977 reflect the fact that final congressional appropriation action for 1976 took place after submission of the President's 1977 budget, resulting in an R&D increase for NIH in 1976 over the level estimated for that year in the budget message.

Mental health and *delivery of health care* are expected to receive decreased funding in 1977; both of these areas also reflect lower support than in 1969. *Drug abuse prevention and rehabilitation* grew rapidly as a program area until 1974 but has since declined considerably.

• **Energy development and conversion** is the leading growth area in Federal R&D funding. The dollar gain of $390 million in 1977 is second only to that of national defense, and the relative gain of 24 percent is far higher than that of any other function. Over the longer term, 1969-77, the average annual growth rate of 26.0 percent for energy is the highest of any major function. As a share of all R&D programs, energy is expected to make up 9 percent in 1977, compared with 2 percent in 1969.

Nuclear energy R&D activities constitute more than three-fifths of the energy function in 1977, with an increase in funding of 45 percent over 1976. The dominant program is ERDA's fission power reactor development where heaviest emphasis is placed on the liquid metal fast breeder reactor (LMFBR). Fuel cycle research and development is also scheduled for greatly increased activity in 1977, and a new reactor safety program is planned. Magnetic fusion experiments on the part of ERDA will be expanded.

Fossil energy programs will make up an estimated one-fifth of all energy R&D programs in 1977, but a decrease in activity is expected. The main factor in the downward shift is the near-completion of coal processing plants, although a number of ERDA coal-related programs will be further stressed.

Under *geothermal, solar, and advanced energy systems* the chief interest is in ERDA's solar energy development, which has grown precipitously since 1974 and will increase an estimated 28 percent in 1977 over 1976.

Conservation of energy is scheduled for a 34-percent increase in 1977, mostly from anticipated work by ERDA on end-use conservation and technologies to improve efficiency.

Other energy efforts in 1977 are entirely those of the Federal Energy Administration.

• **Science and technology base** has risen from a 3-percent share of the Federal R&D total in 1969 to an estimated 4-percent share in 1977. The 14-percent proposed funding increase over 1976 is well ahead of inflation.

Within this area the largest single programs are two conducted by ERDA: basic energy sciences and high-energy physics. Next are 14 science research project support programs of the National Science Foundation (NSF), all of which show growth in 1977 over 1976 and the largest of which are in physics (including high-energy work); materials; physiology, cellular and molecular biology; engineering; and chemistry. Basic research is

supported by the Smithsonian Institution, and physical measurement work continues on the part of the National Bureau of Standards of the Department of Commerce.

• The **environment** function shows a slight decline in 1977 from 1976 but considerable growth over the 1969-77 period during which R&D support has tripled.

Environmental health and safety represent two-fifths of the environment total in 1977 and encompasses a number of programs, of which the leading one is ERDA's biomedical and environmental research.

Understanding, describing, and predicting the environment covers a range of R&D programs, many of them conducted by the National Oceanic and Atmospheric Administration (NOAA) within Commerce, and by NSF.

Pollution control and environmental protection reflects a decrease in 1977 because of reductions in several EPA environmental control programs, especially those in energy-related environmental assessment.

• **Transportation and communications** reflects an overall decline, the result of a drop in the *ground* subfunction.

Air, which accounts for three-fifths of the activity within the whole function in 1977, is largely represented by the NASA aeronautical research and technology program, scheduled for a rise.

Water and *multimodal* R&D programs show little or no change in funding levels.

The *communications* subfunction shows virtually no change. The chief program here is the NASA communications satellite.

• **Natural resources** registers little change in 1977, although this function more than doubled between 1969 and 1977.

Large increases in 1975 and 1976 in the *mineral* subfunction were brought about by growth in Bureau of Mines and Geological Survey activities within the Department of the Interior, but these are now due for decreases.

The *water* subfunction changes very little. It is chiefly represented by programs of the Office of Water Research and Technology (Interior).

The *land* subfunction is scheduled for a slight increase while *recreation* shows virtually no change in 1977.

The *multiresource* subfunction, however is scheduled for a significant rise.

• **Food, fiber, and other agricultural products** almost doubled between 1969 and 1977 and shows a moderate gain in 1977 over 1976.

• Six functions—**education; income security and social services; area and community development, housing, and public services; economic growth and productivity; crime prevention and control;** and **international cooperation and development**—together will account for an estimated 2.8 percent of all Federal R&D obligations in 1977.