REPORT TO THE CONGRESS

How The Federal Government Participates In Activities Affecting The Energy Resources Of The United States

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BY THE COMPTROLLER GENERAL OF THE UNITED STATES

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COMPTROLLER GENERAL OF THE UNITED STATES
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To the President of the Senate and the
Speaker of the House of Representatives

Our report on how the Federal Government participates in activities affecting the energy resources of the United States has been prepared to assist the Congress in its deliberations on matters affecting the Federal energy programs and problems.

Our study was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Virtually all energy demands are presently satisfied by the primary energy sources--oil, natural gas, coal, water, and nuclear energy--and by electricity, which is considered to be a secondary form of energy because it is produced through the conversion of a primary source. Advanced energy sources--geothermal, oil shale, solar, thermonuclear fusion, and others--are looked to with hopeful anticipation for serving future needs.

We are presenting fiscal data--by energy sources--obtained from the Federal agencies on the size and scope of the Federal energy effort in terms of dollars and man-years committed by these Federal agencies in fiscal years 1972 and 1973. (See app. I.) Because of the widespread interest in the Federal research and development efforts in the field of energy, we have prepared special summarizations of the Federal resources committed to such activities. (See apps. II and III.) In addition, we are including a number of charts and certain background material pertaining to primary, secondary, and advanced energy sources; the demand of the

energy-using markets in the United States; and the potential for satisfying such demands.

The Federal effort in the energy field has evolved over the years without the benefit of a formal national energy policy and without centralized direction or coordination. Such effort during fiscal years 1972 and 1973 pertained to the

--enhancement of existing energy sources and supplies,

--research and development of potentially new energy sources,

--determination of new and better ways to protect against adverse effects on the environment caused by development and use of certain sources of energy,

--production and sale of electricity, and

--regulation of energy-producing facilities.

In fiscal year 1972, 23 Federal departments and independent agencies, comprising 64 offices, bureaus, commissions, and administrations, incurred obligations amounting to $3.9 billion and utilized 44,000 man-years of effort for energy-related programs and activities. For fiscal year 1973, these agencies estimated obligations of $5.4 billion and about 45,000 man-years of effort for such programs and activities. The 1973 estimate includes about $660 million in retroactive payments of black-lung-disease benefits to disabled coal miners and coal miners' widows and dependents.

The following table shows that about 95 percent of the amounts obligated during fiscal years 1972 and 1973 (estimated) were related to primary and secondary sources of energy.

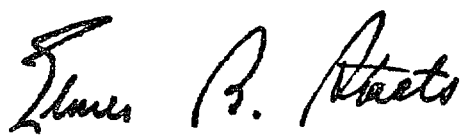
Energy sources	Fiscal year 1972 Amount	Fiscal year 1972 Percent	Fiscal year 1973 (estimated) Amount	Fiscal year 1973 (estimated) Percent
	(millions)		(millions)	
Primary:				
Oil and natural gas	$ 48.5	1.3	$ 55.8	1.0
Coal	548.8	14.2	1,684.6	31.0
Water	469.1	12.2	501.4	9.3
Nuclear energy	927.4	24.0	1,114.4	20.5
	1,993.8	51.7	3,356.2	61.8
Secondary (electricity)	1,635.9	42.4	1,833.2	33.8
Other (advanced and multisource)	229.2	5.9	240.7	4.4
Total	$3,858.9	100.0	$5,430.1	100.0

The number of man-years of Federal employees committed to energy-related activities in 1972 and 1973 is classified by energy sources in the following table.

Energy sources	Man-years Fiscal year 1972	Man-years Fiscal year 1973 (estimated)
Primary:		
Oil and natural gas	1,757	1,791
Coal	4,033	4,401
Water	6,797	6,980
Nuclear energy	2,251	2,269
	14,838	15,441
Secondary (electricity)	26,654	26,710
Other (advanced and multisource)	2,514	2,721
Total	44,006	44,872

We have issued a number of reports on specific aspects of Federal energy-related programs. A listing of such reports issued since January 1968 is included as appendix IV. We have several reviews underway relating to the demand, supply, and research and development aspects of the energy problem. In view of the broad congressional and public interest in this national issue, we have developed plans for intensifying our efforts in this area.

We are sending copies of this report to the Director, Office of Management and Budget, and to the heads of the departments and agencies listed in appendix I.



Comptroller General
of the United States

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ABBREVIATIONS

TVA Tennessee Valley Authority

REA Rural Electrification Administration

CHAPTER 1

ENERGY: A NATIONAL ISSUE

In June 1971 the President of the United States put into focus the critical nature of the energy problem. In his clean energy message to the Congress, he stated that:

> For most of our history, a plentiful supply of energy is something the American people have taken very much for granted. In the past twenty years alone, we have been able to double our consumption of energy without exhausting the supply. But the assumption that sufficient energy will always be readily available has been brought sharply into question within the last year. The brownouts that have affected some areas of our country, the possible shortages of fuel that were threatened last fall, the sharp increases in certain fuel prices and our growing awareness of the environmental consequences of energy production have all demonstrated that we cannot take our energy supply for granted any longer.
>
> A sufficient supply of clean energy is essential if we are to sustain healthy economic growth and improve the quality of our national life.

ENERGY MARKETS AND SOURCES

The United States, with 6 percent of the world's population, uses 35 percent of the world's energy. Historically, although our use of energy rose in proportion with the growth of our industrial economy, our enormous resources made ample energy available in a variety of forms and at reasonable costs.

Until the early 1960s, the energy demand grew at an average annual rate of about 3 percent, a rate slightly less than, but in step with, the growth in the gross national product. Paced by a growth in the electric energy demand of nearly 8 percent a year, the total energy demand increased even faster than the gross national product to an annual growth rate of about 4.8 percent from 1965 to 1970. The annual energy consumption is expected to almost double from

1970 to 1985 and to increase by an additional 50 percent from 1985 to 2000.

In 1970 the U.S. energy-using markets--industrial, electric utilities, transportation, residential, and commercial--required the equivalent of 32.98 million barrels of oil a day. The energy requirements of the five major markets for 1970 and the projected needs by 1985 are compared in the following table.

Energy market	Barrels a day (note a) 1970 Quantity	1970 Percent	1985 Quantity	1985 Percent	Increase from 1970 to 1985 Quantity	Increase from 1970 to 1985 Percent
	(000 omitted)		(000 omitted)		(000 omitted)	
Industrial	10,557	32.0	16,645	26.2	6,088	57.7
Electric utilities	8,154	24.7	23,580	36.9	15,426	189.2
Transportation	8,013	24.3	13,715	21.5	5,702	71.2
Residential	4,567	13.9	6,845	10.8	2,278	49.9
Commercial	1,689	5.1	2,930	4.6	1,241	73.5
Total	32,980	100.0	63,715	100.0	30,735	93.2

[a]Oil equivalent.

Note: A number of charts in this report were obtained from a June 1972 publication of the Chase Manhattan Bank.

As shown above, the total requirements of the energy-using markets are expected to almost double from 1970 to 1985 with the electric utilities market demand increasing by close to 200 percent. The electric utilities market and its growth rate are discussed further on page 25.

The nonrenewable fossil fuels--coal, oil, and natural gas--from domestic and foreign sources provide 96 percent of the total energy consumption of the U.S. economy. The remaining 4 percent is met by waterpower (hydroelectric power) and nuclear power. These five sources are considered the primary sources of energy while electricity is considered a secondary source. Advanced energy sources--geothermal, oil shale, solar, thermonuclear fusion, and others--are looked to with hopeful anticipation for serving future needs. Except for geothermal energy, which accounts for only a small part of today's total energy consumption, these advanced sources have not been used to produce energy for consumption in the United States.

The following table compares the consumption of the five sources of primary energy in 1970 and their predicted use in 1985.

Primary energy source	Barrels a day (note a) 1970 Quantity	1970 Percent	1985 Quantity	1985 Percent	Increase from 1970 to 1985 Quantity	Increase from 1970 to 1985 Percent
	(000 omitted)		(000 omitted)		(000 omitted)	
Oil	14,709	44.6	30,170	47.4	15,461	105.1
Natural gas	10,417	31.6	12,830	20.1	2,413	23.2
Coal	6,497	19.7	10,555	16.6	4,058	62.4
Water	1,247	3.8	1,805	2.8	558	44.7
Nuclear energy	110	.3	8,355	13.1	8,245	7,495.5
Total	32,980	100.0	63,715	100.0	30,735	93.2

[a]Oil equivalent.

The use of oil as an energy source is expected to increase by 105 percent, but oil will supply close to the same percentage of the total energy requirements in 1985--47.4 percent--as in 1970--44.6 percent. The requirements for oil as an energy source, 50 percent of which the United States expects to import by 1985, are of concern to national leaders. According to Government officials, the Nation's reliance on imported energy sources to such an extent could affect its economy and security.

The use of natural gas is expected to increase 23.2 percent by 1985; however, natural gas is expected to supply only 20.1 percent of the total energy requirement in 1985 compared with 31.6 percent in 1970. The use of nuclear power as an energy source is expected to increase from less than 1 percent in 1970 to 13.1 percent in 1985, about 75 times more than the quantity used in 1970.

The use of coal as an energy source is expected to increase by 62.4 percent but to supply a slightly smaller percentage of the total energy requirements in 1985--16.6 percent--as in 1970--19.7 percent. The use of waterpower is expected to increase by 44.7 percent but to supply close to the same percentage of the total energy requirements in 1985--2.8 percent--as in 1970--3.8 percent.

CHAPTER 2

FEDERAL RESOURCES COMMITTED TO PROGRAMS RELATING TO PRIMARY AND SECONDARY ENERGY SOURCES

The total Federal resources committed to energy-related programs in fiscal years 1972 and 1973 are classified by energy sources in the table below. About 95 percent of the amounts obligated during these years were related to primary and secondary sources of energy.

Energy sources	Obligations			
	Fiscal year 1972		Fiscal year 1973	
	Amount	Percent	Amount (note a)	Percent
	(millions)		(millions)	
Primary:				
Oil and natural gas	$ 48.5	1.3	$ 55.8	1.0
Coal	548.8	14.2	1,684.6	31.0
Water	469.1	12.2	501.4	9.3
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	1,993.8	51.7	3,356.2	61.8
Secondary (electricity)	1,635.9	42.4	1,833.2	33.8
Other (advanced and multisource)	229.2	5.9	240.7	4.4
Total	$3,858.9	100.0	$5,430.1	100.0

[a] Estimated.

The number of man-years of Federal personnel committed to energy-related activities in 1972 and 1973 is classified by energy sources in the following table.

Energy source	Man-years	
	Fiscal year 1972	Fiscal year 1973 (note a)
Primary:		
Oil and natural gas	1,757	1,791
Coal	4,033	4,401
Water	6,797	6,980
Nuclear energy	2,251	2,269
	14,838	15,441
Secondary (electricity)	26,654	26,710
Other (advanced and multisource)	2,514	2,721
Total	44,006	44,872

[a]Estimated.

In the following sections of this chapter we present a compilation of fiscal data and background material--by primary and secondary energy sources--pertaining to the consumption and availability of the various energy sources and the nature of the applicable Federal energy-related programs. We have also prepared special summarizations of the Federal resources committed to research and development activities. (See apps. II and III.)

OIL AND NATURAL GAS

Consumption and market data

Oil

Some experts believe that in the year 2000 oil will still be the leading source of energy. Oil is the only primary source of energy that is used in all five energy markets. The relative oil needs of the five major markets for 1970 and their projected needs for 1985 are compared in the following table.

Market	1970	1985
Transportation	54%	46%
Industrial	20	26
Residential	14	11
Electric utilities	7	13
Commercial	5	4
Total	100	100

As shown above, the transportation market was the largest oil consumer--54 percent--in 1970 and is expected to still be the largest in 1985. Although the transportation market's oil consumption is expected to decrease in 1985, oil is virtually the only source that can fill the needs of the transportation market.

Geographically, oil consumption varied considerably in 1970, as shown in the following table.

Region	
East coast	41%
North-central	28
Gulf coast	15
West coast	13
Rocky Mountain	3
Total	100

The percent of total regional use of energy met by oil in 1970 is shown below.

Region	
East coast	57%
West coast	48
Rocky Mountain	40
Gulf coast	37
North-central	36

Natural gas

Natural gas is consumed throughout the country. The natural gas requirements of its four markets (generally natural gas does not serve the transportation market) for 1970 and the projected natural gas needs for 1985 are compared in the following table.

Market	1970	1985
Industrial	50%	41%
Residential	22	30
Electric utilities	18	16
Commercial	10	13
Total	100	100

As shown above, the industrial market was the largest consumer of natural gas in 1970--50 percent--and is expected to still be the largest in 1985. However, its relative consumption is expected to decrease in 1985 to 41 percent.

The gulf coast region uses the most natural gas and the north-central region uses almost as much. Together, these two regions account for more than two-thirds of the total domestic consumption of gas, as shown in the following table.

Region	
Gulf coast	35%
North-central	33
East coast	17
West coast	12
Rocky Mountain	3
Total	100

As a source of energy, natural gas ranks second to oil. The percent of the total regional use of energy being met through use of natural gas in 1970 is shown below.

Region	
Gulf coast	55%
Rocky Mountain	34
West coast	33
North-central	31
East coast	17

Potential for satisfying future energy needs

Oil

Oil is expected to satisfy about 47 percent of the energy needs by 1985. It has been estimated that, if there were no limitations upon the future supply of natural gas, the demand for oil could be expected to grow from 14.7 million barrels a day in 1970 to 26.3 million barrels a day in 1985. But, as a result of the shortage of natural gas and the need for oil as a substitute, the demand for oil is expected to reach 30.2 million barrels a day in 1985--nearly 4 million barrels a day more.

Natural gas

The possible sources of natural gas supply in 1985 and a comparison of the total estimated supply with potential demand in 1985 are shown in the following table.

	Billion cubic feet a day
Domestic production	60.0
Imports from Canada	5.5
Imports of liquid natural gas	6.5
Coal gasification	3.5
Oil gasification	3.0
Total estimated gas supply, 1985	78.5
Potential demand for gas, 1985	107.0
Potential supply deficit	28.5

As shown from the above table, the amount of gas--both natural and synthetic--expected to be available by 1985 will be considerably less than the market needs. Unless new supplies of domestic natural gas become available, the unsatisfied part of the market will be forced to use other sources of primary energy. As discussed earlier, oil is a likely substitute for natural gas. Coal will also be used to make up the natural gas shortage.

Federal resources committed to oil and natural gas programs

There were 18 Federal agencies reporting oil- and gas-related programs and activities in fiscal years 1972 and 1973. Total obligations and man-years are shown below.

Fiscal year	Obligations	Man-years
	(millions)	
1972	$48.5	1,757
1973	[a]55.8	[a]1,791

[a]Estimated.

The major emphasis among the Federal oil and natural gas programs has been on research and development--to explore and develop new sources and to make oil and natural gas energy more environmentally acceptable--and on regulatory and enforcement programs.

Research and development

Of the 18 Federal agencies that committed resources for oil and gas programs, 10 obligated the following amounts for research and development activities during fiscal years 1972 and 1973.

Fiscal year	Obligations	Percent of total obligations for oil and natural gas programs
	(millions)	
1972	$29.1	60.0%
1973	[a]34.7	62.2

[a]Estimated.

A substantial part of the research and development obligations--$18.5 million in fiscal year 1972 and an estimated $20.9 million in fiscal year 1973--was related to finding, developing, and transporting oil and natural gas from the Outer Continental Shelf and Alaska.

The principal agencies making studies in this area include the Atomic Energy Commission which obligated $8 million in fiscal year 1972 and an estimated $8 million in fiscal year 1973 to develop practical technologies for the use of nuclear explosions in mining for natural gas and other natural resources; the National Oceanic and Atomospheric Administration, Department of Commerce, which obligated $6.2 million and an estimated $5.7 million in fiscal years 1972 and 1973, respectively, to conduct surveys of the Outer Continental Shelf and of selected deep-ocean areas in search for oil deposits; and the Geological Survey, Department of the Interior, obligated $1.4 million in fiscal year 1972 and an estimated $3.5 million in fiscal year 1973 to study techniques for transporting oil and natural gas resources from Alaska to the United States and to identify areas on the Outer Continental Shelf having high potential for containing oil and natural gas deposits. The Geological Survey is also studying the environmental impact of offshore exploration.

The remaining resources obligated for research and development during fiscal years 1972 and 1973 were primarily for projects designed to increase environmental safety related to the use of oil and natural gas. One of the largest Federal efforts in the area was research and development being performed by the U.S. Coast Guard, Department of Transportation, on controlling oil pollution.

According to Coast Guard officials, approximately 60 percent of the world's crude oil production, or about 1.8 billion tons, was transported over the oceans in 1969. An estimated 2.3 million tons of crude oil were introduced by man directly into the world's water by such acts as oil spills from vessels and from offshore oil wells. Only about 10 percent of the 2.3 million tons was recoverable for reuse. The Coast Guard obligated $6.4 million in fiscal year 1972 and an estimated $9.1 million in fiscal year 1973 to continue its oil pollution control research.

Regulation and enforcement

Seven Federal agencies obligated resources for fiscal years 1972 and 1973 for regulatory and enforcement programs related to oil and natural gas industries. The total obligations of these agencies were as follows:

Fiscal year	Obligations	Percent of total obligations for oil and natural gas programs
	(millions)	
1972	$18.0	37.1%
1973	[a]19.5	34.9

[a]Estimated.

The principal agencies performing regulation and enforcement activities were the Federal Power Commission, which obligated $10.4 million for fiscal year 1972 and an estimated $11.1 million for fiscal year 1973 to perform various regulatory functions related to the rates and charges for natural gas and to development and transportation of natural gas; the Environmental Protection Agency, which obligated $1.5 million and an estimated $1.7 million for fiscal years 1972 and 1973, respectively, to prevent oil spills and to document violations for recommended enforcement actions; and the Department of Transportation--through its Office of Pipeline Safety and the Coast Guard--which obligated $5.4 million for fiscal year 1972 and an estimated $5.6 million for fiscal year 1973 to administer its oil and natural gas

pipeline safety programs, to carry out its responsibilities under the Water Quality Improvement Act of 1970 (Public Law 91-224), and to patrol shorelines for oil spills.

COAL

Consumption and market data

Following World War II, the demand for coal dropped sharply because the railroads converted from coal-fired steam locomotives to diesel locomotives. The demand for coal decreased even more when many of the markets began looking toward natural gas as their source of energy. In the mid-1960s the coal industry's outlook was further dimmed when electric utilities began to place orders for nuclear power generation stations. Most recently the use of coal by electric utilities and industrial consumers has been partially restricted for environmental reasons.

The coal requirements for the four markets (generally coal does not serve the transportation market) for 1970 and the projected coal needs for 1985 are compared in the following table.

Market	1970	1985
Electric utilities	61%	66%
Industrial	31	28
Residential	3	3
Commercial	5	3
Total	100	100

As shown above, the electric utilities market was the largest consumer of coal in 1970--61 percent--and is expected to remain the largest in 1985--66 percent.

The north-central region, the largest market for coal, and the east coast region, the second largest, accounted for about 90 percent of the total coal consumption in 1970, as shown in the following table.

Region	
North-central	54%
East coast	34
Gulf coast	8
Rocky Mountain	3
West coast	1
Total	100

The following table shows the percent of total use of energy met by coal within each region in 1970.

Region	
North-central	31%
East coast	23
Rocky Mountain	16
Gulf coast	7
West coast	1

Potential for satisfying future energy needs

From a standpoint of U.S. coal resources, the supply is adequate. The total identified and measured resource base, according to the Office of Emergency Preparedness, is enough to last 2,600 years at the current rate of consumption. However, it is not possible to recover all of this coal with current mining technology and under current economic conditions. Approximately 13 percent of the total resource base can be realized with existing technology, and, at the current rate of consumption, the amount of coal available should last several hundred years.

Without limitations upon the future supply of natural gas, the Nation's needs for coal could be expected to grow from 525 million tons consumed in 1970 to 715 million in 1985. As a result of the shortage of natural gas supply and the use of coal as a substitute, the demand for coal is expected to reach 960 million tons in 1985--a third more than would normally be expected.

Federal resources committed to coal programs

In fiscal years 1972 and 1973, 10 Federal agencies reported coal-related programs and activities. Total obligations and man-years are shown below.

Fiscal year	Obligations	Man-years
	(millions)	
1972	$ 548.8	4,033
1973	[a]1,684.6	[a]4,401

[a]Estimated.

The greatest part of the above Federal resources was committed to programs relating to the health and safety of coal miners and to researching coal conversion techniques.

Coal mine health and safety

There are two Federal agencies which have obligated the following amounts under programs relating to the health and safety of coal miners during 1972 and 1973.

Fiscal year	Obligations	Percent of total obligations for coal programs
	(millions)	
1972	$ 499.8	91.1
1973	[a]1,610.4	95.6

[a]Estimated.

Of the total resources obligated for coal-related programs, the Social Security Administration, Department of Health, Education, and Welfare, obligated $429.4 million and an estimated $1,526.5 million for fiscal years 1972 and 1973, respectively, for payments of black-lung-disease benefits to disabled coal miners and coal miners' widows and dependents under the Federal Coal Mine Health and Safety Act of 1969 (30 U.S.C. 801). The 1973 estimate includes about $660 million in retroactive benefits for periods prior to 1973.

In addition, the Bureau of Mines, Department of the Interior, obligated $70.4 million and an estimated $83.9 million in fiscal years 1972 and 1973, respectively, to improve working conditions in mines to achieve safer environments for miners.

Research and development

Of the 10 Federal agencies that committed resources for coal programs, seven obligated the following amounts for research and development activities for fiscal years 1972 and 1973.

Fiscal year	Obligations	Percent of total obligations for coal programs
	(millions)	
1972	$ 78.6	14.3
1973	[a]102.2	6.1

[a]Estimated.

Federal research is seeking a way to convert coal into a more environmentally acceptable energy source. Three major areas that have been emphasized are coal gasification, liquefaction, and desulfurization.

Agencies performing conversion research include (1) the Office of Coal Research, Department of the Interior, which obligated $29.3 million for fiscal year 1972 and an estimated $39.3 million for fiscal year 1973 to research the conversion of coal to nonpolluting gaseous and liquid fuels and to develop the desulfurization of coal and (2) the Bureau of Mines which obligated $9.2 million for fiscal year 1972 and an estimated $13.9 million for fiscal year 1973 for coal liquefaction and coal gasification research.

Coal gasification is being studied because it provides a possible supplement to the diminishing supply of natural gas and because it offers a method of burning coal with lower sulfur oxide emissions. Although a process of manufacturing synthetic gas from coal is presently available for commercial use, the cost is high. Gasification processes are being developed for the manufacture of pipeline-quality gas which will be more economically suitable than presently known processes.

The President's clean energy message of June 1971 called for an expanded program to convert coal into a clean, gaseous fuel and called for a cooperative effort between

Government and industry to meet this goal. An agreement between the Office of Coal Research and the American Gas Association has been entered into for the construction and operation of three pilot gasification plants. Under the agreement an estimated $120 million will be spent over a 4-year period, with the Government's providing about two-thirds of the funding. Three pilot plants, two of which have been constructed, should be in operation during 1975.

The incentives for coal liquefaction--conversion of coal into liquid fuels--are similar to those for coal gasification in that liquefaction could provide a cleaner way of using coal and thus reduce the demand for petroleum products (oil and natural gas) which are diminishing in availability. Federal research to develop an acceptable liquefaction conversion technique is continuing, principally under the Office of Coal Research.

Removing sulfur oxides (desulfurization) is a major challenge toward making coal burning more environmentally acceptable from an air quality control standpoint. Desulfurization, gasification, and liquefaction are ways to increase coal use to meet future energy demands. In addition, desulfurization may be a more immediate concern than gasification or liquefaction because it is needed to keep existing coal-fired steam plants operating within environmental constraints.

According to the National Petroleum Council, commercially acceptable technology for controlling sulfur oxides is not presently available. However, the Environmental Protection Agency, the Tennessee Valley Authority (TVA), and the Department of the Interior, as well as industry, are funding numerous projects to find ways to control stack gas emissions.

WATER

Consumption and market data

About 3.8 percent of the total energy consumed in the United States during 1970 was derived from waterpower (hydropower). Waterpower is used almost entirely in generating electricity for the electric utility market. Of all the electricity produced in the United States in 1970, approximately 15 percent was generated with waterpower.

About 60 percent of the waterpower generated in this country in 1970 was used in the west coast region. The 1970 consumption of waterpower, by regions, is shown in the table below.

Region	
West coast	60%
East coast	17
North-central	9
Rocky Mountain	8
Gulf coast	6
Total	100

The following table shows the percent of total regional use of energy met in 1970 by waterpower.

Region	
West coast	18%
Rocky Mountain	10
East coast	2
North-central	1
Gulf coast	1

Potential for satisfying future energy needs

There is a limit to the number of sites in the United States where low-cost waterpower can be developed. Because of the relatively few remaining sites that can be developed and used, the amount of electricity generated with waterpower is not likely to increase by more than 45 percent between

1970 and 1985. Waterpower is likely to constitute about 2.8 percent of the 1985 expected primary energy consumption.

Federal resources committed to water-related energy programs

There were five Federal agencies that committed resources for water-related programs in fiscal years 1972 and 1973. The total obligations and man-years are shown below.

Fiscal year	Obligations	Man-years
	(millions)	
1972	$469.1	6,797
1973	[a]501.4	[a]6,980

[a]Estimated.

The major Federal effort in the waterpower area pertains to constructing, operating, and maintaining powerplants and transmission facilities and regulating hydroelectric power markets. Government agencies did little research and development effort in this area.

Federal water operations

The major Federal agencies involved in constructing, operating, and maintaining hydroelectric projects are the Corps of Engineers, Department of the Army; the Bureau of Reclamation, Department of the Interior; and TVA. These agencies[1] committed the following resources for hydroelectric production in fiscal years 1972 and 1973.

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[1]Excluding TVA, which, because of its reliance on several of the primary energy sources and its transmission activities serving the energy derived from these sources, has been included in the section on Electricity: Secondary Energy. (See p. 27.)

Fiscal year	Obligations	Percent of total obligations for water-related energy programs
	(millions)	
1972	$462.9	98.7%
1973	[a]494.2	98.6

[a]Estimated.

Through the Federal hydroelectric construction and operation programs of these agencies, in 1970 there were 131 Federal power plants throughout the country having an installed electric generating capacity of 22.8 million kilowatts.

Regulation and enforcement

The Federal Power Commission is the only Government agency having regulation and enforcement responsibility for hydroelectric power. The Commission obligated the following resources for these activities in fiscal years 1972 and 1973.

Fiscal year	Obligations	Percent of total obligations for water-related energy programs
	(millions)	
1972	$ 3.8	(a)
1973	[b]4.3	(a,b)

[a]Less than 1%.

[b]Estimated.

As part of its responsibilities, the Commission issues and administers permits and licenses for planning, constructing, and operating non-Federal hydroelectric facilities on water or lands subject to Federal jurisdiction. As of December 31, 1970, about 580 facilities were under Commission license. In approving the licensing and relicensing of these projects, the Commission is responsible for determining that the project is best adapted to a comprehensive plan for developing and using the water resources of the river basins for all beneficial purposes.

NUCLEAR ENERGY

Consumption and market data

The use of nuclear energy is virtually limited to the generation of electricity by electric utilities. It is not practicable, as yet, to use it directly for industrial, commercial, transportation, and residential purposes.

Less than 1 percent of the energy consumed in the country in 1970 was from nuclear sources. Most of that was on the east coast and in the north-central region. By 1985 as much as 35 percent of the total consumption of energy by the electric utility market is expected to be derived from nuclear sources. Despite this anticipated rapid growth, nuclear energy is expected to constitute only about 13 percent of the total primary energy supply by 1985.

Potential for satisfying future energy needs

The use of nuclear energy to generate electricity is expected to grow at an exceptionally fast rate between 1970 and 1985. The table below shows the expected use of nuclear energy in 1985 in each region of the country.

Region	
East coast	44%
North-central	24
West coast	16
Gulf coast	14
Rocky Mountain	2
Total	100

The demand on our resources of coal, oil, and gas is being, and will be, relieved by the nuclear power plants we are now using and building. It has been estimated that, if we continue to build and operate only the types of nuclear power plants that we have today, in about 30 years we will have consumed the total amount of economically usable nuclear fuel now known to exist. An answer to this problem lies in the breeder reactor.

A breeder reactor is a reactor that produces more fuel than it consumes. If the breeder reactor can be used in a nuclear powerplant, it can provide the heat needed for the generation of electricity and, simultaneously, produce an excess of fissionable material that can be used to fuel other plants. A joint private- and Government-sponsored research effort to develop a practical breeder reactor is underway.

Federal resources committed to nuclear energy programs

There were seven Federal agencies reporting nuclear-related programs and activities in fiscal years 1972 and 1973. The obligations and man-years are shown below.

Fiscal year	Obligations	Man-years
	(millions)	
1972	$ 927.4	2,251
1973	[a]1,114.4	[a]2,269

[a]Estimated.

The primary emphasis among Federal nuclear-related programs was on research and development to develop improved nuclear energy sources.

Research and development

Seven Federal agencies had the following obligations for research and development activities.

Fiscal year	Obligations	Percent of total obligations for nuclear energy programs
	(millions)	
1972	$ 626.8	67.6
1973	[a]760.2	68.2

[a]Estimated.

The Atomic Energy Commission is the principal Federal agency performing research in the nuclear energy area. The Commission obligated $621 million for fiscal year 1972 and an estimated $753 million for fiscal year 1973, of which 60 percent and 55 percent, respectively, were obligated for work on nuclear reactors and uranium enrichment. Other agencies performing research include the National Aeronautics and Space Administration which obligated $4.1 million for fiscal year 1972 and an estimated $1.5 million for fiscal year 1973 on nuclear power conversion technologies for use in space operations; the Maritime Administration, Department of Commerce, which obligated $588,000 for fiscal year 1972 and an estimated $1.2 million for fiscal year 1973 on a study of the economics of a nuclear steam generator for ships; and the Geological Survey which obligated $716,000 for fiscal year 1972 and an estimated $822,000 for fiscal year 1973 on a study of methods of locating and investigating new uranium districts.

Nuclear power reactors

The Atomic Energy Commission's obligations for fiscal years 1972 and 1973 include $345 million and an estimated $365 million, respectively, for research and development of nuclear power reactors. The Atomic Energy Commission described the objectives of its research as follows:

--To develop and demonstrate the technology which will permit the practical use of nuclear energy for the production of electricity and other process applications, to maximize exploitation of the energy latent in nuclear sources, and to establish a self-sufficient and growing nuclear industry.

--To develop and demonstrate the technology necessary to design, construct, and operate safely and economically large breeder power reactors.

Uranium enrichment

The Atomic Energy Commission is continuing its research to achieve advanced technology in the operation of its gaseous diffusion plants for production of enriched uranium and to expand production capacity of these plants. The Commission obligations for this work in fiscal years 1972 and 1973 were $25 million and an estimated $50 million, respectively.

Other Federal activities
related to nuclear energy

Of primary importance to the expanded use of nuclear energy are the Federal resources being employed to monitor and protect against the potential adverse environmental effects from nuclear radiation. For fiscal years 1972 and 1973, the Environmental Protection Agency obligated $1.5 million and an estimated $1.8 million, respectively, to carry out its nuclear monitoring activities. The Agency obligated $675,000 for fiscal year 1972 and an estimated $570,000 for fiscal year 1973 to perform environmental surveillance around nuclear facilities and to inspect localities in which uranium has been used as construction fill material. The Agency obligated an additional $864,500 for fiscal year 1972 and an estimated $1.2 million for fiscal year 1973 for the review of environmental impact statements on nuclear powerplants and related facilities and for engineering studies needed to support these reviews.

ELECTRICITY: SECONDARY ENERGY

Consumption and market data

Electricity is a secondary form of energy because it is produced by converting a primary source of energy. Per capita consumption of electricity in the United States more than doubled between 1955 and 1970. In 1970 the electric utility market consumed the equivalent of 8,154,000 barrels of oil a day in the generation of electricity; only 2,495,000 equivalent barrels of oil came through the process in the form of electricity to be consumed by the industrial, commercial, and residential markets. The difference was lost in the process of conversion.

The electric utility market is unique in that it is the only market that uses all five primary energy sources--oil, gas, coal, waterpower, and nuclear energy. The electric utility market has relied heavily on coal as the principal source for producing electricity. Coal represented almost half of the primary energy consumed during 1970 in the production of electricity, and natural gas represented almost a quarter. Waterpower and nuclear energy are virtually limited to the production of electricity. Primary energy sources used in the production of electricity are expected to change considerably in the next 15 years, as indicated in the following table.

Primary energy sources	1970	1985
Coal	49%	29%
Natural gas	24	11
Water	15	8
Oil	11	17
Nuclear energy	1	35
Total	100	100

Of the total electric utility market, more than one-third is located in the north-central region of the United States with almost another third located in the east coast region. These two regions, which contain 72 percent of the Nation's population, account for two-thirds of the primary energy used in the generation of electricity.

Potential for satisfying future energy needs

Energy consumption for electric power generation has been growing faster than that consumed in the other energy-using markets in the United States. Its growth rate has increased from 7 percent a year between 1961 and 1965 to 8.6 percent a year between 1965 and 1969, to 9.25 percent in 1970. The projected growth rate over the 15-year period 1970 to 1985 is expected to be 6.7 percent.

Electric utilities have ordered a large number of nuclear power generating plants. Many additional orders are in the planning stage and are likely to be placed soon. By 1985 nuclear power is expected to emerge as the single largest source of primary energy used in the production of electricity. Nuclear power alone is expected to accommodate more than half of the growth in the overall energy requirements of the electric utility market between 1970 and 1985.

Federal resources committed to electrical energy programs

Since all five primary energy sources are used in the generation of electrical energy, the data presented in the preceding sections of this chapter relating to the primary energy sources pertained, in part, to electrical energy. For example, the resources committed by Federal agencies to coal-related, water-related, and nuclear-related activities were also, to some degree, related to electrical energy programs. In addition Federal agencies are committing resources for other facets of electrical energy programs. For fiscal years 1972 and 1973, 14 agencies, including TVA, committed the following resources for such programs.

Fiscal year	Obligations	Man-years
	(millions)	
1972	$1,635.9	26,654
1973	[a]1,833.2	26,710

[a]Estimated.

Emphasis in the use of these resources was on programs relating to generation, transmission, and marketing; research and development; regulation and enforcement; and financing of electric cooperatives.

Generation and transmission

TVA obligated the following amounts for generating and transmitting electricity for fiscal years 1972 and 1973.

Fiscal year	Obligations	Percent of total obligations for electricity programs
	(millions)	
1972	$1,042.9	63.8
1973	[a]1,043.6	56.9

[a]Estimated.

TVA performs the following activities related to the generation and transmission of electricity.

--Operating and maintaining generating and transmitting facilities and delivering power to local distribution systems and to Federal and industrial establishments with large or unusual power requirements.

--Building an extensive network of extra-high voltage and low voltage transmission lines and substations.

--Investigating and exploring alternative plans for future power facilities to determine the future plant size and location, unit size, and fuel systems for thermal plants.

--Designing and constructing additional generating facilities to supply future electrical energy requirements.

--Developing facilities to improve the air quality at steam generation projects.

The Federal effort also includes a number of agencies directing substantial resources toward constructing transmission facilities for hydroelectric power and marketing power from Federal hydroelectric generating projects. Four administrations within the Department of the Interior--Alaska Power Administration, Bonneville Power Administration, Southeastern Power Administration, and Southwestern Power Administration--are responsible for transmitting and marketing the electricity generated at Federal hydroelectric projects in their respective areas. The four administrations obligated the following amounts to carry out their responsibilities in fiscal years 1972 and 1973.

Fiscal year	Obligations	Percent of total obligations for electricity programs
	(millions)	
1972	$140.2	8.6
1973	[a]152.6	8.3

[a]Estimated.

Bonneville, the largest of the Federal power marketing administrations, with obligations of $118.9 million in fiscal year 1972 and an estimated $130.1 million in fiscal year 1973, constructs transmission system facilities and exchanges power from Federal hydroelectric plants with non-Federal hydroelectric and thermal plants owned by public and private utilities in the Pacific Northwest. The other three power administrations perform similar functions in their areas of the country.

Research and development

Seven Federal agencies committed resources to perform research and development activities in fiscal years 1972 and 1973. The following table shows their obligations.

Fiscal year	Obligations	Percent of total obligations for electricity programs
	(millions)	
1972	$ 7.5	(a)
1973	[b]10.5	(a, b)

[a]Less than 1 percent.

[b]Estimated.

Among Federal research and development resources, the primary emphasis was on identifying and perfecting new generation and transmission techniques.

The National Science Foundation obligated $1.6 million and an estimated $2.2 million for fiscal years 1972 and 1973, respectively, on research projects to improve electrical transmission systems and in efforts to computerize the operating, planning, and modeling of transmission systems.

Regulation and enforcement

Two Federal agencies were involved in performing regulatory and enforcement activities during fiscal years 1972 and 1973. Obligations for these activities are shown in the table below.

Fiscal year	Obligations	Percent of total obligations for electricity programs
	(millions)	
1972	$6.7	(a)
1973	[b]7.4	(a, b)

[a]Less than 1 percent.

[b]Estimated.

The major Federal agency involved with regulating the electric utilities is the Federal Power Commission which obligated $6 million and an estimated $6.4 million for fiscal

years 1972 and 1973, respectively. The Commission is responsible for:

--Regulating the wholesale rates of public utilities selling electricity in interstate commerce.

--Studying the power needs.

--Studying interconnections between electric utility companies for the purpose of promoting areawide coordination.

--Analyzing environmental impact statements of electric utilities.

Financing of electric cooperatives

The Rural Electrification Administration (REA) assists electric utility companies in providing dependable and modern electric service in rural areas. This assistance was provided through low-cost loans to finance the construction of generation, transmission, and distribution facilities. REA committed the following resources for these activities for fiscal years 1972 and 1973.

Fiscal year	Obligations	Percent of total obligations for electricity programs
	(millions)	
1972	$438.3	26.8
1973	[a]618.0	33.7

[a]Estimated.

CHAPTER 3

FEDERAL RESOURCES COMMITTED TO PROGRAMS RELATING TO ADVANCED ENERGY SOURCES

Federal resources are being directed toward researching and exploring advanced energy sources for future use. These amounts represented about 1 percent of the total Federal resources committed for energy-related programs in fiscal years 1972 and 1973.

There were 10 Federal agencies engaged in research and development of advanced energy sources. The total obligations and man-years for these agencies are shown below.

Fiscal year	Obligations	Man-years
	(millions)	
1972	$61.8	332
1973	[a]61.4	360

[a]Estimated.

Advanced sources under study include geothermal energy, oil shale, solar energy, and the development of thermonuclear fusion technology. Other possible energy sources include tidal power, windpower, and ocean currents.

A discussion of some of these advanced energy sources under study and the related Federal efforts follows.

GEOTHERMAL ENERGY

Geothermal energy is the natural heat of the earth. It can be tapped to generate electricity to heat homes and to help meet the energy requirements. Although the magnitude of this resource is largely unknown, it has been estimated that, if only 1 percent of the heat in the top 6 miles of the earth's crust could be developed, this source would exceed all known fossil fuel reserves. The potential for geothermal energy development has not been fully tested because

federally owned geothermal resources became eligible for leasing only recently with the passage of the Geothermal Steam Act of 1970 (Public Law 91-581).

The Geological Survey and the Bureau of Reclamation led the Federal effort in exploring and developing geothermal energy in fiscal years 1972 and 1973. These agencies obligated the following resources for development of geothermal energy.

Agency	Fiscal year 1972 Obligations	Fiscal year 1972 Man-years	Fiscal year 1973 Obligations (note a)	Fiscal year 1973 Man-years
	(thousands)		(thousands)	
Geological Survey	$ 696.9	29	$2,521.0	44
Bureau of Reclamation	800.0	10	1,200.0	20
Total	$1,496.9	39	$3,721.0	64

[a]Estimated.

The major efforts of the Geological Survey concerned (1) a survey to identify potential geothermal areas in the country and (2) an evaluation of geothermal resources on public lands. The Bureau of Reclamation is studying the methods for developing geothermal resources.

OIL SHALE

Oil shale is fine-grained sedimentary rock that contains a solid organic material--kerogen--which, when properly processed, will yield a fluid hydrocarbon or oil. Experts believe that it is one of our greatest potential sources of energy and that it may help fill a widening energy gap in the United States.

There are 11 million acres of land--of which 8.3 million acres are public land managed by the Federal Government--known to contain deposits of oil shale from which oil can be recovered for commercial use, although no shale oil is being produced in the United States. On June 29, 1971, the

Secretary of the Interior announced a proposed prototype leasing program to develop the oil shale resources in Federal lands in Colorado, Utah, and Wyoming believed to have the greatest potential for oil shale development. Under the direction of the Department of the Interior, the proposed program makes a limited number of leases available for private development under carefully controlled conditions.

As the principal Federal agency involved in the oil shale program, the Bureau of Mines obligated $2.6 million in fiscal year 1972 and an estimated $2.6 million in fiscal year 1973 to provide the scientific and engineering competence needed to (1) establish and administer a national oil shale policy, (2) insure its efficient development, and (3) help stimulate industry to initiate the commercial production of shale oil.

SOLAR ENERGY

According to scientists, the greatest energy source of all is the sun which pours onto the earth 100,000 times as much energy as the world's present electric power capacity. Conversion of solar energy for use in the home is one potential use receiving increased attention. It has been estimated that up to 50 percent or more in household fuel use may be saved through the use of solar energy.

The National Science Foundation is studying solar energy as a fuel saver and supplement to conventional methods of heating and cooling. In fiscal year 1972 and 1973, the Foundation obligated $3.2 million and an estimated $6.2 million, respectively, to research and develop devices to change the form of energy from that which occurs naturally to that which is practical for transmission and use. The Foundation emphasized the study of new technologies using solar energy and other, less conventional sources and for new methods of energy storage.

THERMONUCLEAR FUSION

The Atomic Energy Commission is engaged in research to demonstrate the scientific feasibility of producing electrical energy using the fusion process and to lay the groundwork for production of such energy in significant quantities. Controlled thermonuclear fusion occurs when certain light

atoms, which are heated to a high temperature in a confined region, collide and rearrange themselves to form a smaller mass with a consequent release of energy.

The essential fuel material for fusion is heavy hydrogen or deuterium, which is present in all natural water. In theory, the amount of energy produced by the fusion of the deuterium nuclei (the small, positively charged cores of atoms) present in 1 gallon of water is equal to that obtainable from the combustion of 300 gallons of gasoline. The enormous amounts of water available on earth represent a virtually inexhaustible potential source of energy.

The Commission committed the following resources for the development of controlled thermonuclear fusion.

Fiscal year	Obligations	Man-years
	(millions)	
1972	$33.0	12
1973	[a]40.0	12

[a]Estimated.

RESOURCES COMMITTED BY FEDERAL AGENCIES

FOR ENERGY-RELATED ACTIVITIES

FISCAL YEARS 1972 AND 1973

Federal agencies	Resources: Obligations 1972	Resources: Obligations 1973 (note a)	Resources: Man-years 1972	Resources: Man-years 1973 (note a)
	(thousands)			
APPALACHIAN REGIONAL COMMISSION	$ 476.7	$ 285.0	-	-
ATOMIC ENERGY COMMISSION	938,000.0	1,110,000.0	1,914	2,070
COUNCIL ON ENVIRONMENTAL QUALITY	75.0	250.0	3	4
DEPARTMENT OF AGRICULTURE:				
Forest Service	4,130.0	5,330.0	236	318
Rural Electrification Administration	438,300.0	618,000.0	433	433
Soil Conservation Service	2,509.0	2,453.0	166	164
DEPARTMENT OF COMMERCE:				
Bureau of the Census	61.0	57.0	6	5
Maritime Administration	1,400.0	1,972.0	2	2
National Bureau of Standards	1,729.0	1,551.0	51	41
National Oceanic and Atmospheric Administration	6,161.0	5,718.0	296	220
Office of Import Programs	100.0	255.0	5	15
Regional Action Planning Commission	150.0	464.0	-	-
DEPARTMENT OF DEFENSE:				
Office of Naval Petroleum and Oil Shale Reserves	4,888.0	5,275.0	38	38
U.S. Army Corps of Engineers (Civil)	266,940.0	271,240.0	4,430	4,560
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE:				
Social Security Administration	429,370.0	1,526,500.0	900	1,225
DEPARTMENT OF THE INTERIOR:				
Alaska Power Administration	679.0	881.0	23	25
Bonneville Power Administration	118,851.0	130,050.0	3,443	3,400
Bureau of Land Management	5,729.0	6,065.0	252	270
Bureau of Mines	91,103.1	111,686.0	3,392	3,392
Bureau of Reclamation	197,000.0	224,400.0	2,062	2,072
Bureau of Sport Fisheries and Wildlife	521.0	851.0	22	40
Defense Electric Power Administration	82.6	85.0	3	3
Geological Survey	19,842.9	24,187.0	800	834
Office of Coal Research	30,350.0	46,490.0	30	37
Office of Oil and Gas	1,726.0	1,725.0	74	79
Southeastern Power Administration	5,287.0	5,952.0	37	37
Southwestern Power Administration	18,840.0	20,603.0	186	188
DEPARTMENT OF JUSTICE:				
Antitrust Division	814 0	814.0	42	42
Lands and Natural Resources Division	30.0	45.0	2	3
DEPARTMENT OF LABOR:				
Bureau of Labor Statistics	185.0	310.0	16	21
Employment Standards Administration	500.0	500.0	25	25
Labor Management Services Administration	5,000.0	5,000.0	30	30
Manpower Administration	43,000.0	43,000.0	35	35
Occupational Safety and Health Administration	900.0	1,700.0	35	46
Solicitor's Office	71.0	71.0	5	5

APPENDIX I

Federal agencies	Resources: Obligations 1972	Resources: Obligations 1973 (note a)	Resources: Man-years 1972	Resources: Man-years 1973 (note a)
	(thousands)			
DEPARTMENT OF STATE	$ 458.2	$ 483.1	19	19
DEPARTMENT OF TRANSPORTATION:				
Federal Aviation Administration	12,266.0	12,685.0	30	29
Federal Highway Administration	4.0	4.0	1	1
Federal Railroad Administration	609.2	1,017.0	10	11
National Transportation Safety Board	53.0	64.0	2	2
Office of the Secretary	13,421.2	11,065.0	51	52
U.S. Coast Guard	12,580.0	16,030.0	407	450
Urban Mass Transportation Administration	969.0	366.0	1	1
DEPARTMENT OF THE TREASURY	20.0	111.0	1	6
ENVIRONMENTAL PROTECTION AGENCY:				
Office of the Administrator	57.0	125.0	5	5
Office of Air and Water Programs	14,725.4	15,353.9	156	157
Office of the Assistant Administrator for Enforcement and General Counsel, General Enforcement	680.6	3,202.2	43	170
Office of the Assistant Administrator for Enforcement and General Counsel, Water Enforcement	258.2	200.0	11	10
Office of Categorical Programs, Office of Radiation Programs	1,649.5	1,950.0	90	96
Office of Categorical Programs, Office of Solid Waste Management Programs	9,630.0	510.0	13	11
Office of Enforcement and General Counsel, Office of Permit Programs	1,000.0	1,000.0	65	60
Office of Planning and Management, Office of Planning and Evaluation	496.5	327.0	5	3
Office of Research and Monitoring	36,464.5	43,500.1	375	395
FEDERAL POWER COMMISSION	20,211.0	21,809.0	1,074	1,092
FEDERAL TRADE COMMISSION	319.2	504.7	20	27
INTERSTATE COMMERCE COMMISSION	75.0	75.0	5	5
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION:				
Office of Aeronautics and Space Technology, Space Propulsion and Power Division	5,800.0	5,500.0	131	130
Office of Manned Space Flight	2,050.0	1,140.0	18	16
Space Nuclear Systems Office	4,100.0	1,500.0	240	40
NATIONAL SCIENCE FOUNDATION	15,736.6	19,523.0	8	13
OFFICE OF EMERGENCY PREPAREDNESS (note b)	978.0	1,180.0	34	38
OFFICE OF SCIENCE AND TECHNOLOGY (note b)	140.0	145.0	5	5
SMALL BUSINESS ADMINISTRATION	225.0	225.0	-	-
TENNESSEE VALLEY AUTHORITY	1,069,132.0	1,096,778.0	22,192	22,349
Total	$3,858,910.4	$5,430,138.0	44,006	44,872

[a]Estimated.

[b]Abolition proposed under Reorganization Plan No. 1, 1973.

FEDERAL RESOURCES COMMITTED TO ENERGY-RELATED RESEARCH AND DEVELOPMENT ACTIVITIES (BY AGENCIES)

Federal agencies	Obligations 1972	Obligations 1973 (note a)	Man-years 1972	Man-years 1973 (note a)
	(thousands)			
APPALACHIAN REGIONAL COMMISSION	$ 476.7	$ 285.0	-	-
ATOMIC ENERGY COMMISSION	662,000.0	801,000.0	881	921
DEPARTMENT OF AGRICULTURE:				
Forest Service	2,330.0	3,090.0	121	183
DEPARTMENT OF COMMERCE:				
Maritime Administration	1,400.0	1,972.0	2	2
National Bureau of Standards	1,729.0	1,551.0	51	41
National Oceanic and Atmospheric Administration	6,161.0	5,718.0	296	220
Regional Action Planning Commission	-	14.0	-	-
DEPARTMENT OF THE INTERIOR:				
Alaska Power Administration	250.0	250.0	5	5
Bonneville Power Administration	3,226.0	4,039.0	39	50
Bureau of Land Management	-	775.0	-	15
Bureau of Mines	50,918.1	56,344.0	1,342	1,342
Bureau of Reclamation	1,000.0	1,400.0	17	27
Bureau of Sport Fisheries and Wildlife	521.0	851.0	22	40
Geological Survey	7,842.9	11,487.0	286	320
Office of Coal Research	30,350.0	46,490.0	30	37
DEPARTMENT OF LABOR:				
Bureau of Labor Statistics	185.0	310.0	16	21
Manpower Administration	43,000.0	43,000.0	35	35
DEPARTMENT OF TRANSPORTATION:				
Federal Aviation Administration	12,266.0	12,685.0	30	29
Federal Railroad Administration	415.2	800.0	-	-
National Transportation Safety Board	53.0	64.0	2	2
Office of the Secretary	11,990.0	9,327.0	22	22
U.S. Coast Guard	7,313.0	10,493.0	73	105
Urban Mass Transportation Administration	969.0	366.0	1	1
ENVIRONMENTAL PROTECTION AGENCY:				
Office of Air and Water Programs	12,027.1	12,752.0	25	29
Office of Categorical Programs, Office of Radiation Programs	110.0	180.0	5	7
Office of Categorical Programs, Office of Solid Waste Management Programs	9,630.0	510.0	13	11
Office of Research and Monitoring	33,927.5	40,770.1	370	390
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION:				
Office of Aeronautics and Space Technology	5,800.0	5,500.0	131	130
Office of Manned Space Flight	2,050.0	1,140.0	18	16
Space Nuclear Systems Office	4,100.0	1,500.0	240	40
NATIONAL SCIENCE FOUNDATION	15,736.6	19,523.0	8	13
OFFICE OF EMERGENCY PREPAREDNESS (note b)	382.0	447.0	2	3
TENNESSEE VALLEY AUTHORITY	3,196.0	9,747.0	91	176
Total	$931,355.1	$1,104,380.1	4,174	4,233

[a]Estimated.

[b]Abolition proposed under Reorganization Plan No. 1, 1973.

FEDERAL RESOURCES COMMITTED TO ENERGY-RELATED RESEARCH AND DEVELOPMENT ACTIVITIES (BY SOURCE OF ENERGY)

	Amount		Man-years	
	1972	1973 (note a)	1972	1973 (note a)
	(thousands)			
Primary energy sources:				
Oil and natural gas	$ 29,079.0	$ 34,694.0	722	703
Coal	78,629.9	102,177.0	1,063	1,106
Water	2,200.0	2,700.0	107	157
Nuclear energy	626,844.0	760,191.0	1,130	1,026
	736,752.9	899,762.0	3,022	2,992
Secondary energy sources (electricity)	7,486.0	10,486.0	114	133
Advanced energy sources:				
Geothermal energy, oil shale, solar energy, thermonuclear fusion	61,768.8	61,431.0	332	360
Total for energy sources	806,007.7	971,679.0	3,468	3,485
Other (multisource)	125,347.4	132,701.1	706	748
Total	$931,355.1	$1,104,380.1	4,174	4,233

[a]Estimated.

GENERAL ACCOUNTING OFFICE

REPORTS ISSUED SINCE JANUARY 1968

RELATING TO THE ENERGY AREA

B- number	Title	Date
B-114858	Examination of Financial Statements of Columbia River Federal Power System (1967)	1-22-68
B-114850	Examination of Financial Statements (1967), Tennessee Valley Authority	1-29-68
B-125042	Need for Change in Method of Computing the Cost of Power Sold for Commercial Purposes, Missouri River Basin Project	3-18-68
B-114858	Need for Improved Coordination of Transmission Line Design and Construction Practices	8- 5-68
B-125042	Discounts Granted Generating and Transmission Cooperatives, Eastern Division, Missouri River Basin Project	8- 6-68
B-114858	Examination of Financial Statements of Columbia River Federal Power System (1968)	12-16-68
B-125031	Examination of Financial Statements of Southwestern Federal Power System for Fiscal Year 1967	12-19-68
B-114850	Examination of Financial Statements (1968), Tennessee Valley Authority	3-25-69
B-159687	Possible Transfer of the Gaseous Diffusion Plants to Private Ownership	5-20-69
B-114858	Examination of Financial Statements of The Federal Columbia River Power System (1969)	12-23-69

APPENDIX IV

B- number	Title	Date
B-167712	Change Proposed in Interest Rate Criteria for Determining Financing Costs of the Federal Power Program	1-13-70
B-125045	Questionable Aspects Concerning Information Presented to the Congress on Construction and Operation of the San Luis Unit, Central Valley Project	2-12-70
B-118678	Opportunity for Benefits Through Increased Use of Competitive Bidding to Award Oil and Gas Leases on Federal Lands	3-17-70
B-114850	Examination of Financial Statements (1969), Tennessee Valley Authority	4-15-70
B-168798	Inappropriate Source of Power Used as Basis for Allocating Costs of Water Resources Projects	5-25-70
B-159868	Conversion of Heating Furnaces from Coal to Oil at Military Installations in Europe	7-14-70
B-159687	Proposed Revisions to the Price and Criteria for Uranium Enrichment Services	7-17-70
B-164064	Assurances Needed that Cost of the Celilo-Mead Transmission Line Project Will be Recovered	8- 5-70
B-164105	Problems in Developing the Fast Flux Test Facility	9-23-70
B-114858	Examination of Financial Statements of Federal Columbia River Power System (1970)	12-21-70
B-164052	Progress and Problems in Programs for Managing High-level Radioactive Waste	1-29-71

B- number	Title	Date
B-159687	Price Increase and Change In Criteria For Uranium Enrichment Services	2- 9-71
B-114850	Examination of Financial Statements (1970), Tennessee Valley Authority	3-31-71
B-125045	Opportunities for Improvement in the Development and Evaluation of Design Alternatives for Federal Water Resources Projects, Including Projects of the Bureau of Reclamation, Department of the Interior	4- 6-71
B-170686	Problems in Implementation of the Federal Coal Mine Health and Safety Act of 1969	5-13-71
B-114858	Charges for Use of Federal Electric Power Transmission Lines Should Be Reevaluated	9-29-71
B-114858	Examination of Financial Statements of Federal Columbia River Power System for Fiscal Year 1971	12-30-71
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APPENDIX IV

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B-170686	Improvements Needed in the Assessment and Collection of Penalties--Federal Coal Mine Health and Safety Act of 1969	7- 5-72
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