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Recent Trends in Energy Research and Development Expenditures

R. J. Moe, Project Manager

J. R. Kee
K. C. Lackey
F. J. Cronin

February 1985

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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RECENT TRENDS IN ENERGY RESEARCH AND DEVELOPMENT EXPENDITURES

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Pacific Northwest Laboratory
Richland, Washington 99352

EXECUTIVE SUMMARY

Pacific Northwest Laboratory (PNL) has prepared this report for the Department of Energy, Office of Industrial Programs (OIP). The objective of this report is to analyze recent trends in industrial research and development (R&D) spending, using data provided by the National Science Foundation. The specific emphasis of the report is energy and energy conservation R&D expenditures. Analyzing the causes of recent R&D expenditure trends was outside of the scope of the study, as was collecting primary R&D expenditure data from industrial firms.

This objective was achieved by performing two tasks. The first task was to collect and assemble data on industrial R&D expenditures in the United States from the National Science Foundation (NSF), Office of Industrial Studies. The NSF data base contains information on R&D expenditures by year for each of the years 1975-1982, by two- and three-digit Standard Industrial Code (SIC), and by R&D type (total, energy, and energy conservation). The NSF defines R&D as either basic investigatory research, without commercial objectives; applied research with commercial objectives; or technical activities concerned with creating or developing new products or processes. Energy R&D is any R&D activity concerned with investigating or developing new uses of energy. Energy conservation R&D, a subset of energy R&D, is any R&D activity concerned with investigating or developing new energy-saving products or processes.

The data cover the expenditures for R&D performed by private industry, including R&D that is both financed and performed by private industry and R&D that is financed by the government (federal, state, and/or local) but performed by the private sector. The data do not cover expenditures for R&D that was actually performed by the government (such as research performed by the National Institutes of Health or the National Bureau of Standards). Although the NSF has recently released this data to the public in a report entitled R&D in Industry: 1982 Statistical Tables, to our knowledge the data has not yet been used to perform an analysis of the type reported in this paper. In addition to the information on R&D expenditures, data on the Gross

National Product (GNP) implicit price deflator for the years 1975-1982 was obtained from the 1984 Economic Report of the President.

The second task was to graphically and numercially analyze recent trends in total, energy-related, and energy conservation R&D expenditures. Total R&D and energy R&D expenditures for the period 1975-1982 were analyzed for each of nine industries: chemicals, petroleum, primary metals, machinery, electrical equipment, aircraft and missiles, professional and scientific instruments, other manufacturing, nonmanufacturing. Energy conservation R&D expenditures for this period were analyzed for each of six industries: chemicals, primary metals, machinery, electrical equipment, other manufacturing, and nonmanufacturing. In addition, for all three types of R&D, trends in expenditures for all industries combined were analyzed.

The findings of this task are summarized in Tables ES.1 and ES.2 and Figures ES.1, ES.2, and ES.3. As shown in Table ES.1, between 1975 and 1982, real (inflation-adjusted) total R&D expenditures by all industries combined increased at an annual average rate of 5.6 percent. Real energy-related R&D expenditures by all industries increased at an annual average rate of 5.6 percent for the entire 1975-1982 period; however, they increased at an annual average rate of 10.6 percent between 1975 and 1980, and decreased at an annual average rate of 5.3 percent between 1980 and 1982. Real energy conservation expenditures by all industries increased at an annual average rate of 11.1 percent for the entire 1975-1982 period; however, they increased at an annual average rate of 49.8 percent between 1975 and 1979, but decreased at an annual average rate of 25.2 percent between 1979 and 1982.

Although energy R&D expenditures and total R&D expenditures for all industries combined increased at identical annual rates during the 1975-1982 period, energy R&D expenditures increased at higher annual average rates than total R&D expenditures in seven of the nine individual industries analyzed. Conservation R&D expenditures increased at higher average annual rates than either energy or total R&D expenditures in four of the five individual industries for which comparisons could be made. As might be expected, total R&D increased at the highest average annual rate in the professional and scientific instruments industry, which includes the electronics industry. Energy R&D expenditures grew at the highest annual average rate in the

TABLE ES.1. Annual Average Rates of Change in Real U.S. Research and Development Expenditures, by Industry and Type of R&D, 1975 - 1982

	Type of R&D		
	Total	Energy	Energy Conservation
Chemicals	.054	.085	.185
Petroleum	.076	.083	NA(a)
Primary Metals	.045	.122	.204
Machinery	.058	.261	-.023
Electrical Equipment	.049	.017	.124
Aircraft and Missiles	.057	.067	NA(a)
Professional and Scientific Instruments	.110	.184	NA(a)
Other Manufacturing(b)	.036	-.002	.074
Nonmanufacturing	.085	.127	.260
Total Industry	.056	.056	.111

(a) Not available, included in "Other Manufacturing" category.
(b) The Energy Conservation average annual rate of change should not be compared to the Total and Energy rates for this industry because the industry is defined differently for the Energy Conservation column than for the Total and Energy columns.

machinery industry. Energy conservation R&D expenditures increased at the highest annual average rate in the nonmanufacturing (primarily commercial) and primary metals industries.

The real average annual rates of increase presented in Table ES.1 may be somewhat misleading, for two reasons. First, although real energy and energy conservation R&D expenditures increased in most of the individual industries at higher annual average rates than real total R&D expenditures, the actual real dollar increases that occurred between 1975 and 1982 were much larger for total R&D than for either energy or energy conservation R&D. For example, as shown in Table ES.2, real total industrial R&D

TABLE ES.2. Real U.S. Research and Development Expenditures, by Industry and Type of R&D, 1975, Peak Year, and 1982
(Millions of 1972 Dollars)

	Type of R&D							
	Total		Energy			Energy Conservation		
	1975	1982[a]	1975	Peak	1982	1975	Peak	1982
Chemicals	2164	3137	81	(d)	165	3	27	11
Petroleum	550	921	321	(d)	563	NA[b]	NA[b]	NA[b]
Primary Metals	352	479	21	(d)	48	2	14	8
Machinery	2537	3751	18	(d)	92	1	8	1
Electrical Equipment	4052	5678	368	517	416	6	30	14
Aircraft and Missiles	4534	6688	106	251	168	NA[b]	NA[b]	NA[b]
Professional	931	1927	11	(d)	36	NA[b]	NA[b]	NA[b]
Other Manufacturing[c]	3499	4521	403	566	401	26	121	44
Nonmanufacturing	584	1046	78	198	182	1	11	8
Total Industry	19228	28451	1410	2330	2091	41	207	87

(a) For total R&D expenditures, 1982 was the peak year for each of the nine industries, so a separate "Peak Year" column is not shown.
(b) Not available, included in "Other Manufacturing" category.
(c) This industry is defined differently for the Energy Conservation columns than for the Total and Energy Columns.
(d) Peak year was 1982.

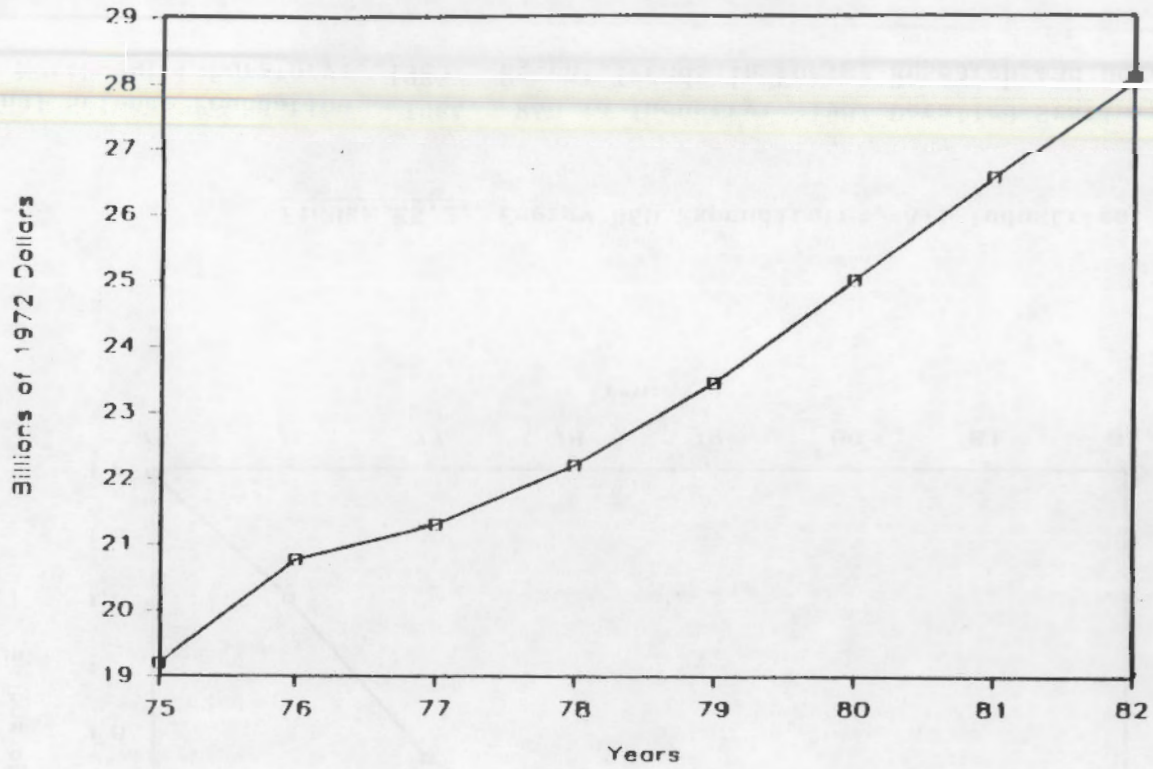

FIGURE ES.1. Total R&D Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

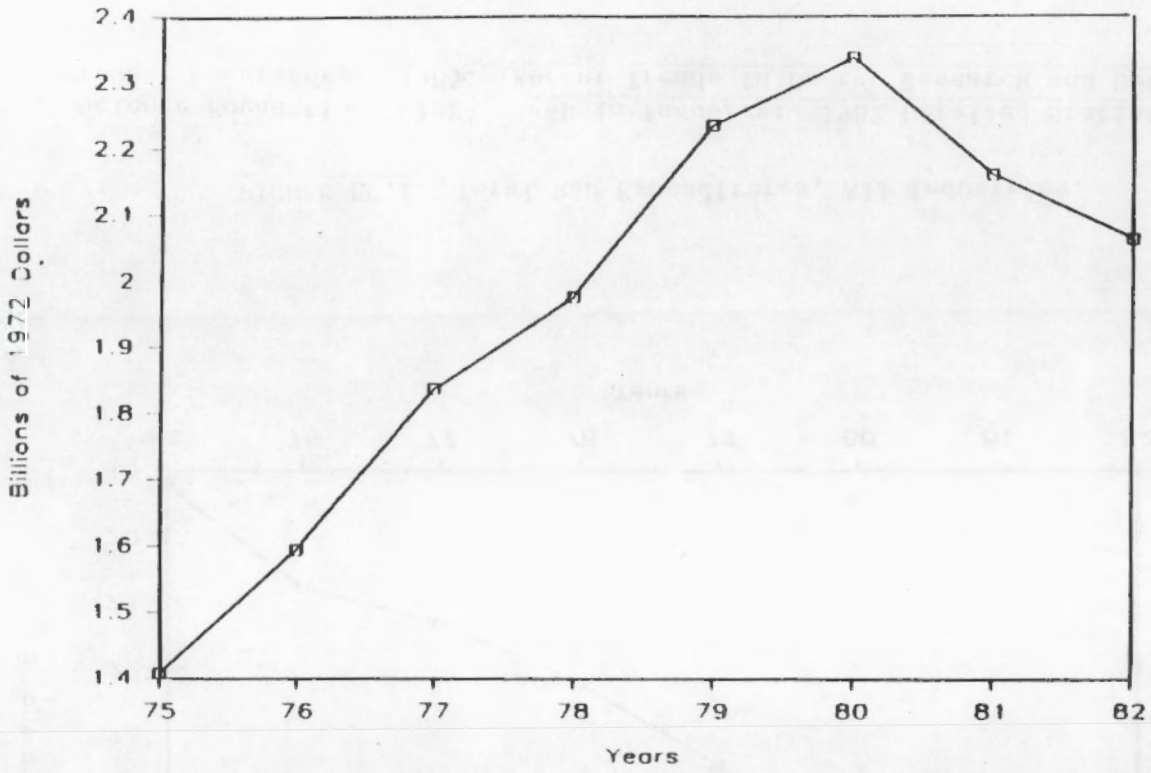

FIGURE ES.2. Energy R&D Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

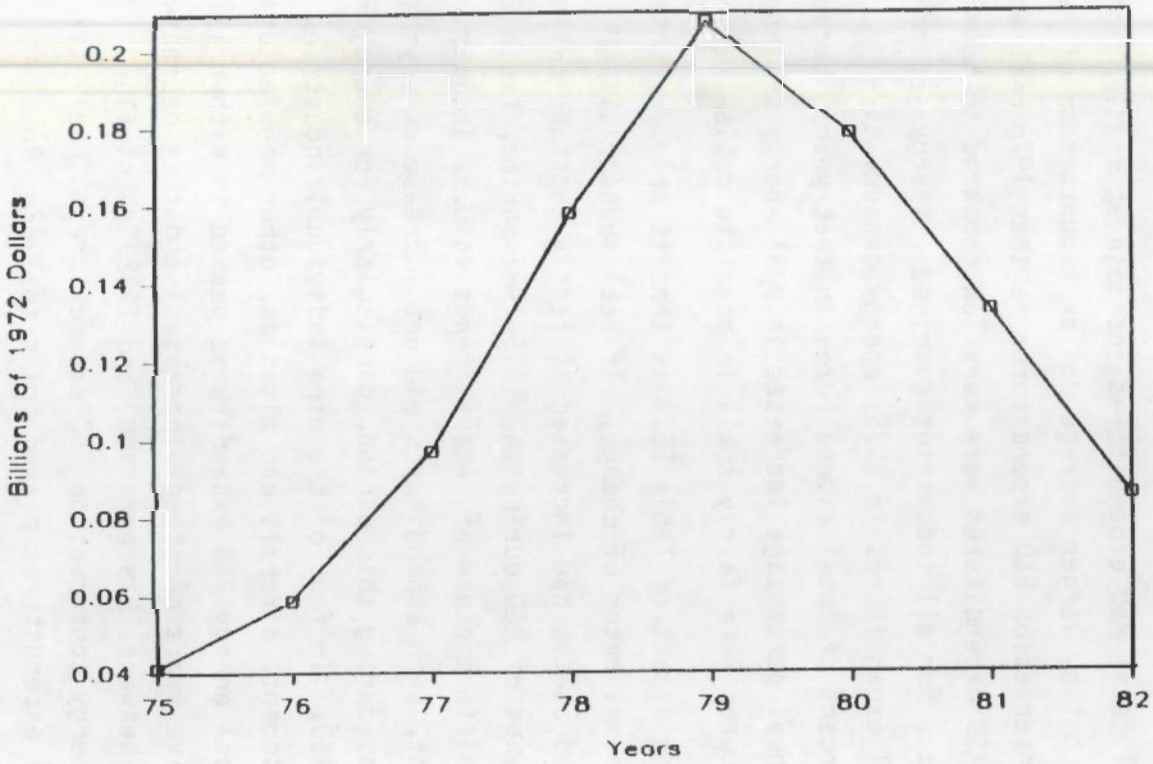

FIGURE ES.3. Energy Conservation R&D Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

expenditures for all industries combined increased from $19,228 million in 1975 to $28,451 million in 1982, an average increase of $1,318 million per year. Real energy R&D expenditures increased by all industries an average of $97 million per year between 1975 and 1982. Real energy conservation R&D expenditures by all industries increased an average of $7 million per year between 1975 and 1982. Similar examples could be drawn from most of the individual industries analyzed.

The reason that real total R&D expenditures increase at smaller annual average percentage rates but by larger average dollar amounts than either real energy or energy conservation R&D expenditures is that 1975 real energy and energy conservation R&D expenditures were very low compared to total R&D expenditures. In fact, for all industries combined , energy expenditures were 7.3 percent of total expenditures in 1975; energy conservation expenditures were 0.2 percent of total expenditures in that year. Because of this, fairly large annual percentage increases in real energy and energy conservation R&D expenditures were fairly small in absolute dollar amounts.

The second misleading aspect of Table ES.1 is that it only presents information on average annual rates of change. If real industrial R&D expenditures in the United States had increased at fairly constant rates for all industries and all types of R&D during the 1975-1982 period, Table ES.1 would paint a fairly complete picture of recent trends in U.S. industrial R&D expenditures. In fact, such expenditures did not increase at anything approaching constant rates during this period, particularly for energy R&D and energy conservation R&D. In four of the nine individual industries analyzed (electrical equipment, aircraft and missiles, other manufacturing, and nonmanufacturing), real energy R&D expenditures peaked in either 1979 or 1980 (after four or five years of steady increases) and then decreased at fairly constant rates between 1979 (or 1980) and 1982. A similar phenomenon occurred in energy conservation R&D expenditures: in all six industries analyzed, real expenditures peaked prior to 1982. Real expenditures peaked in machinery in 1977, in electrical equipment and other manufacturing in 1979, and in primary metals and nonmanufacturing in 1980. In all six industries, real energy conservation R&D expenditures increased at fairly constant (and very high) rates between 1975 and the peak year,

but then decreased at fairly constant (and, again, very high, though not quite as high as the previous rates of increase) rates between the peak year and 1982. Regarding total R&D expenditures, in only one of the nine industries analyzed (other manufacturing) did real expenditures peak prior to 1982.

This phenomenon is shown graphically in Figures ES.1, ES.2, and ES.3, which display the annual R&D expenditures in billions of 1972 dollars for each of the three types of R&D for all industries combined. Note that the vertical axes of these figures are scaled differently, reflecting the fact that energy R&D expenditures are a very small share of total R&D expenditures and that energy conservation R&D expenditures are a very small proportion of energy R&D expenditures. Real total R&D expenditures by all industries increased at a near-constant rate between 1975 and 1982, as shown in Figure ES.1. Real energy expenditures by all industries increased at near-constant rates between 1975 and 1980, but decreased in both 1981 and 1982, as displayed in Figure ES.2. As Figure ES.3 shows, real energy conservation R&D expenditures by all industries increased at near-constant (and very high) rates between 1975 and 1979, but decreased almost as dramatically between 1979 and 1982. For all three categories of R&D, real expenditures by individual industries exhibited similar tendencies.

CONTENTS

FIGURES

FIGURES (cont.)

1.0 INTRODUCTION

This report was prepared by Pacific Northwest Laboratory for the U.S. Department Energy, Office of Industrial Programs (OIP). The study analyzes recent trends in industrial expenditures on research and development (R&D) of energy-using and energy-saving devices and methods.

1.1 BACKGROUND

Due to the relatively small productivity increases and the slowdown in real R&D spending growth experienced during the 1970s, concern about industrial R&D activity has dramatically increased in recent years. Output per man hour increased 32.2 percent between 1960 and 1970, but increased only 14.6 percent between 1970 and 1980, and actually fell in 1979 and 1980. Similarly, although real R&D spending increased 23 percent between 1973 and 1981, this rate of increase was less than half the growth rate of 51 percent experienced in real R&D spending during the 1963-1971 period. Such a reduction in the rate of growth of R&D investment may reduce long-term technological progress, and, in turn, endanger future productivity increases. In turn, a slowdown in technological progress may, over time, diminish our potential for continued economic strength.

Much less attention has been paid to recent trends in energy-related R&D expenditures and the impact of such expenditures. Research and development expenditures relating to energy affect the U.S. economy by enhancing energy efficiency as well as the productivity of labor and equipment. An increase in energy-related R&D expenditures and the resulting technological improvements facilitate the development of energy-saving devices and methods. These tools and capabilities enable industries to make better use of the energy they consume and reduce the amount of energy actually required. In addition, such R&D expenditures lead to development of devices and methods that generally increase industrial productivity and that lead to new consumer and industrial products.

1.2 OBJECTIVE

The objective of this report is to summarize recent trends in industrial energy-related R&D activity using data provided by the National Science

Foundation. Analyzing the causes of these trends was outside of the scope of this study, as was collecting primary R&D expenditure data from industrial firms. The results of this report are intended to provide DOE/OIP with information about recent energy R&D expenditures trends that it can use to identify problems in industrial activities.

1.3 OVERVIEW OF REPORT

The remainder of this report is organized as follows. Chapter 2.0 presents conclusions and recommendations of the study. Chapter 3.0 presents the data used in the analysis. Chapter 4.0 presents a quantitative assessment of total, energy, and conservation R&D expenditure trends.

2.0 CONCLUSIONS AND RECOMMENDATIONS

In brief, the study yielded the following conclusions:

- o While total R&D expenditures for all industries combined increased during every year in this period, energy and energy conservation R&D expenditures for all industries combined peaked in 1980 and 1979, respectively, and have been declining at constant rates since.
- o Total, energy and energy conservation R&D expenditures for all industries combined were higher in 1982 than in 1975, so that annual average rates of change were positive for all three categories for the period. This phenomenon occured in almost all of the industries analyzed.
- o Real energy and energy conservation R&D expenditures began the 1975-1982 period as small proportions of total real R&D spending (7.3 percent and 0.2 percent, respectively, for all industries combined in 1975) and generally ended the period as small proportions of total spending (7.3 percent and 0.3 percent respectively, for all industries combined in 1982). This phenomena occured in most of the industries analyzed.

Based upon these conclusions, the following recommendations are made:

- o Real energy R&D expenditures and, particularly, real energy conservation R&D expenditures have been decreasing during the past several years and appear likely to continue to decrease in the absence of policy intervention. To the extent that future industrial productivity increases, industrial strength, and "energy independence" are dependent on such expenditures (which we did not examine), policies to reverse the declines in these expenditures may be warranted.
- o Further research should be performed on the recent trends in industrial R&D expenditures. Longer time series and more disaggregated expenditure data (e.g., by 4-digit SIC, by financing source, by type of R&D) would be useful in determining how strong recent trends have been and the likelihood that they will continue. Research on the causes of the recent trends in R&D expenditures and on the effects of R&D expenditures

on industrial productivity and industrial energy use should also be performed.

3.0 DATA DEVELOPMENT

This chapter describes the data used in the trends analysis presented in chapter 4.0. The sources of this data are discussed in section 3.1. The data are described in detail in section 3.2.

3.1 DATA SOURCES

Two general types of data were used in the analysis presented in chapter 4.0. First, data on annual industrial R&D expenditures by industry and R&D type were used. Second, the annual U.S. Gross National Product (GNP) implicit price deflator was used.

All industrial R&O expenditures data were obtained from the National Science Foundation survey, R&D in Industry: 1982 Oetailed Statistical Tables.(a) The data from this survey are collected and compiled by the Bureau of the Census, U.S. Department of Commerce.

Data on GNP implicit price deflator were obtained from the 1984 Economic Report of the President, published by the Council of Economic Advisers, Executive Office of the President.(b) These data are collected by the Bureau of Economic Analysis, U.S. Department of Commerce.

3.2 OATA DESCRIPTION

The two types of data used in the analysis are described in greater detail below.

3.2.1 Description of R&D Expenditure Data

The NSF survey of industrial R&D consists of annual R&D expenditure data for each of the years 1972 to 1982. The industrial R&D data is organized according to Standard Industrial Classification (SIC) codes for 15 manufacturing industries: Food and Kindred Products; Textiles and Apparel; Lumber; Wood Products and Furniture; Petroleum Refining and Related Industries; Rubber Products; Stone, Clay and Glass Products; Primary Metals;

(a) National Science Foundation. 1984. R&D in Industry: 1982 Statistical Tables. NSF84-325. Washington,D. C.

(b) Council of Economic Advisers. 1984. Economic Report of the President. United States Government Printing Office, Washington, D. C.

Fabricated Metal Products; Machinery; Motor Vehicles and Motor Vehicles Equipment; Other Transportation Equipment; Aircraft and Missiles; Professional and Scientific Instruments; and Other Manufacturing. Data for nonmanufacturing industries and a total for all indutries is also provided.

For several industry groupings, the NSF reported data as unavailable. This occurred when there was: 1) an extremely high sampling error; 2) a high rate of interpolation (over 50 percent); 3) a failure of a company to supply data; 4) disclosure of an individual company; and/or 5) inconsistency for inclusion in time series. Because of these suppressions, and in order to ensure a high degree of accuracy in analyzing R&D expenditure trends, total and energy R&D expenditures for the period 1975-1982 were aggregated in this study into nine industrial categories: Chemical and Allied Products; Petroleum Refinery and Related Industries; Primary Metals; Machinery; Electrical Equipment; Aircraft and Missiles; Professional and Scientific Instruments; Other Manufacturing; and Nonmanufacturing, in addition to a total for all industries. The "Other Manufacturing Industry" used here is a composite of NSF's "Other Manufacturing Industry"; Food and Kindred Products; Textiles and Apparel; Lumber; Wood Products and Furniture; Rubber Products; Stone, Clay, and Glass Products; Fabricated Metal Products; Motor Vehicles; and Other Transportation Equipment. For the energy conservation expenditures, expenditure data were aggregated into six industries categories: Chemical and Allied Products; Primary Metals; Machinery; Electrical Equipment; Other Manufacturing; and Nonmanufacturing, in addition to a total for all industries. The "Other Manufacturing Industry" here includes the industries that made up "Other Manufacturing" for total and energy R&D expenditures, plus the Petroleum Refining and Related Industries, Aircraft and Missiles, and Professional and Scientific Instruments.

The NSF reports data by R&D type, for three types of R&D: total, energy, and energy conservation. Total R&D is defined as the total of all expenditures on R&D activities for a given year. R&D is defined by NSF as basic and applied research in sciences and engineering and the design and development of prototypes and processes. Research is differentiated as basic and applied research on the basis of original investigation.

Basic research means an original investigation, one that has no commercial objective; otherwise the research is classified as applied. Development is defined by NSF as nonroutine technical activities concerned with creating products or processes from research findings.

Energy R&D is defined by the Organization for Economic Cooperation and Development (OECD) as R&D performed "in support of the supply, production, and conservation and distribution of all forms of energy (except means of propulsion for vehicles and rockets)". The NSF uses this definition as well.

Energy conservation is defined by the NSF as R&D undertaken to reduce consumption of energy, either at the point of energy use or in the transmission, transportation, storage, or coversion of energy. Examples are R&D undertaken primarily to reduce fuel consumption in manufacturing, to improve the efficiency of transformation of energy products, and to produce an end product that is more efficient in energy utilization.

The data include expenditures for all R&D activities performed by private industry. The source of financing of the activity is not considered: both R&D activity financed by industry and that financed by government (federal, state, and/or local) but performed by industry are included. R&D actually performed by the government, however, was not included.

R&D data are collected from a sample of approximately 11,500 companies. These companies are chosen primarily from two sources; the Fiscal Year 1981 Standard Statistical Establishment List and the Enterprise Statistical Multiunit File, which are compiled by the Bureau of the Census. The NSF uses the expenditure data from this sample to estimate expenditures for the entire population of industries.

The data collected from the NSF are presented in current dollars in Table A.1 of the Appendix.

3.2.2 Description of Price Deflator

The GNP implicit price deflator was used to deflate all R&D expenditures into real, 1972 dollars. The price deflator is an index equal to 100 in 1972. It is a measure of the price level, similar to the more-familiar Consumer Price Index (CPI). It indexes the general price level of all of

the goods and services produced in the United States, not just the price level of a typical "market basket" of consumer-purchased goods and services (as in the case of the CPI). The price deflator data used in the analysis are presented in Table A.2 of the Appendix.

4.0 ANALYSIS OF R&D EXPENDITURE TRENDS

Using the data base described in chapter 3.0, trends in real R&D expenditures during the 1975-1982 period were analyzed for each of nine industries, as well as for all industries combined. All R&D data presented in this section were deflated by the GNP implicit price deflator (1972 = 1.00), and are thus measured in real, inflation-adjusted 1972 dollars. For all but three of the industries, (Petroleum, Aircraft and Missiles, and Professional and Scientific Instruments), trends in expenditures for all three types of R&D were analyzed; for the three exceptions, trends in energy conservation R&D expenditures could not be examined due to incomplete data series. Trends for the nine individual industries are examined in sections 4.1 through 4.9. Expenditure trends for all industries combined are described in section 4.10.

4.1 CHEMICALS INDUSTRY

Figures 4.1 (a), (b), and (c) show real R&D expenditure trends for the Chemicals Industry (SIC 28). Real total R&D expenditures increased at an annual average rate of .04 (i.e., 4 percent) during the 1975-1982 period. Year-to- year changes were fairly constant during the period, with a small decrease occurring in 1978 and annual increases accelerating in the 1980-1982 period. As shown in Figure 4.1 (b), real energy R&D expenditures also increased dramatically during the 1972-1982 period, at an annual average rate of .085. Again, increases were fairly steady, with a small decrease in 1978. Energy conservation R&D expenditures, however, demonstrate completely different behavior, as shown in Figure 4.1 (c). For the entire 1975-1982 period, real expenditures increased at an annual average rate of .185. However, real expenditures increased at a much higher rate than this in the 1975-1980 period, then fell dramatically in 1981 and 1982.

Figures 4.1 (d) and (e) show real energy and energy conservation R&D expenditures as a percentage of real total R&D expenditures for the industry. Energy's share of total R&D expenditures increased from just below 4 percent in 1975 to approximately 5.5 percent in 1981, before falling slightly in 1982. Energy conservation's share of total R&D expenditures

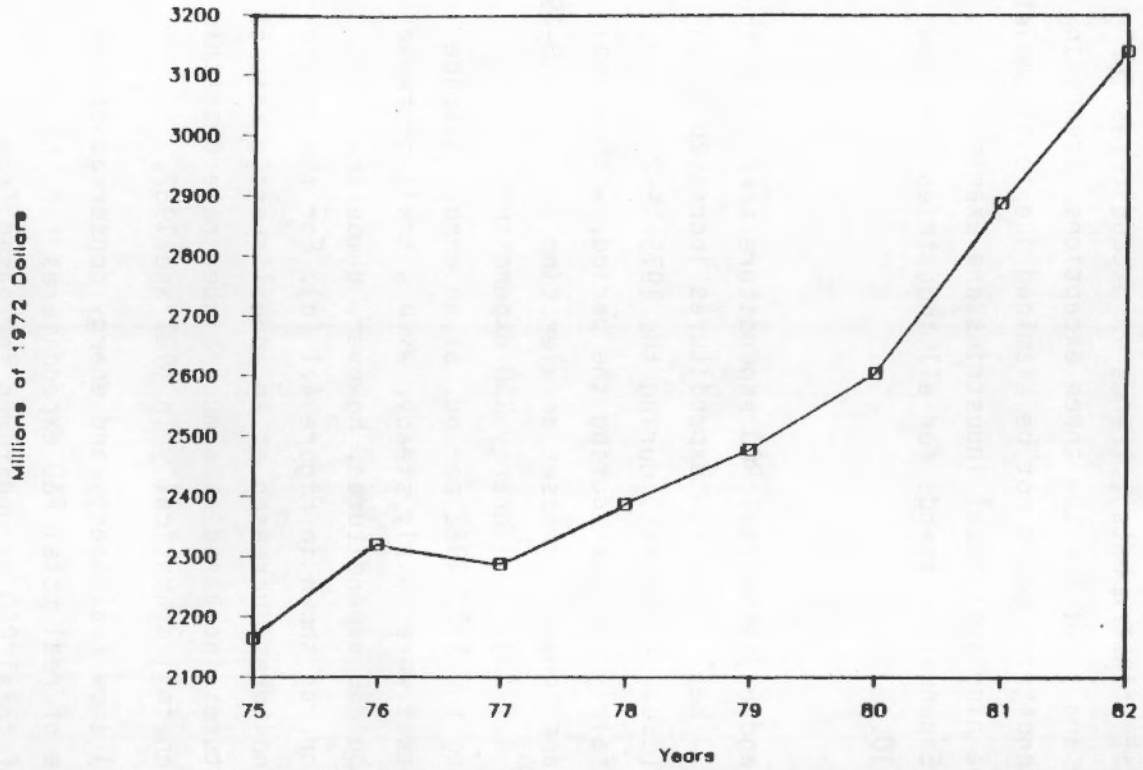

FIGURE 4.1(a). Total R&D Expenditures, Chemicals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

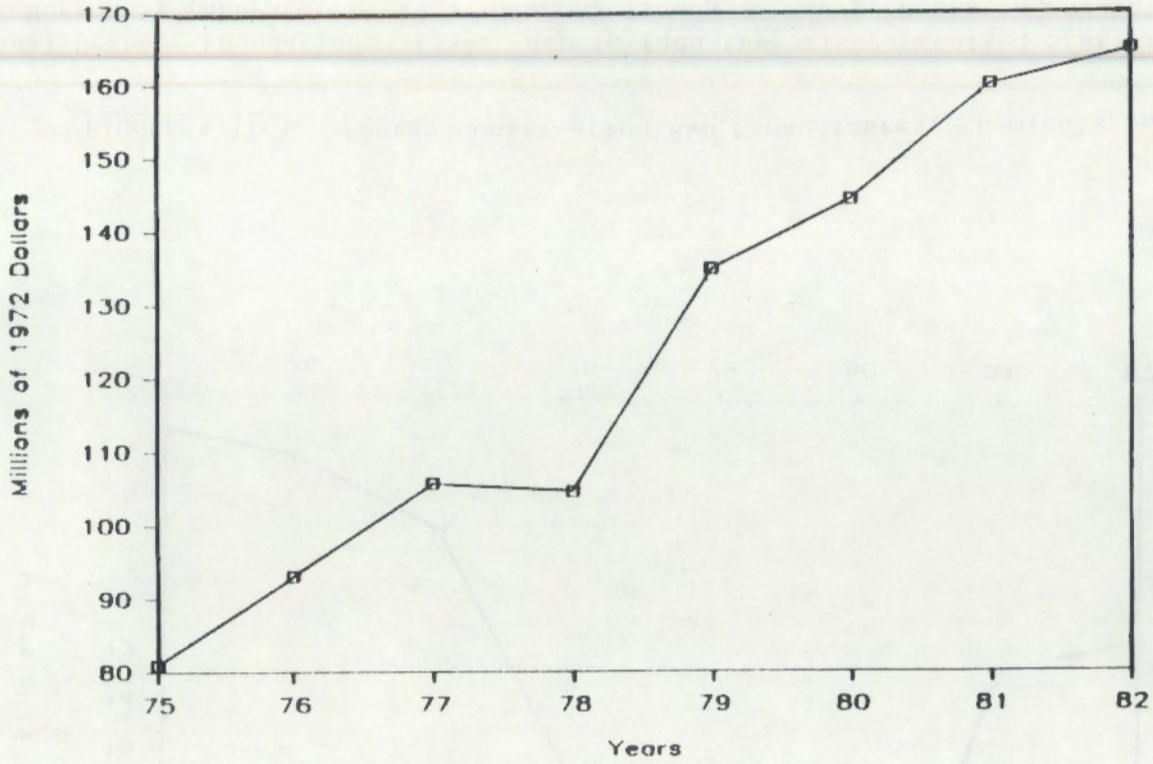

FIGURE 4.1(b). Energy R&D Expenditures, Chemicals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

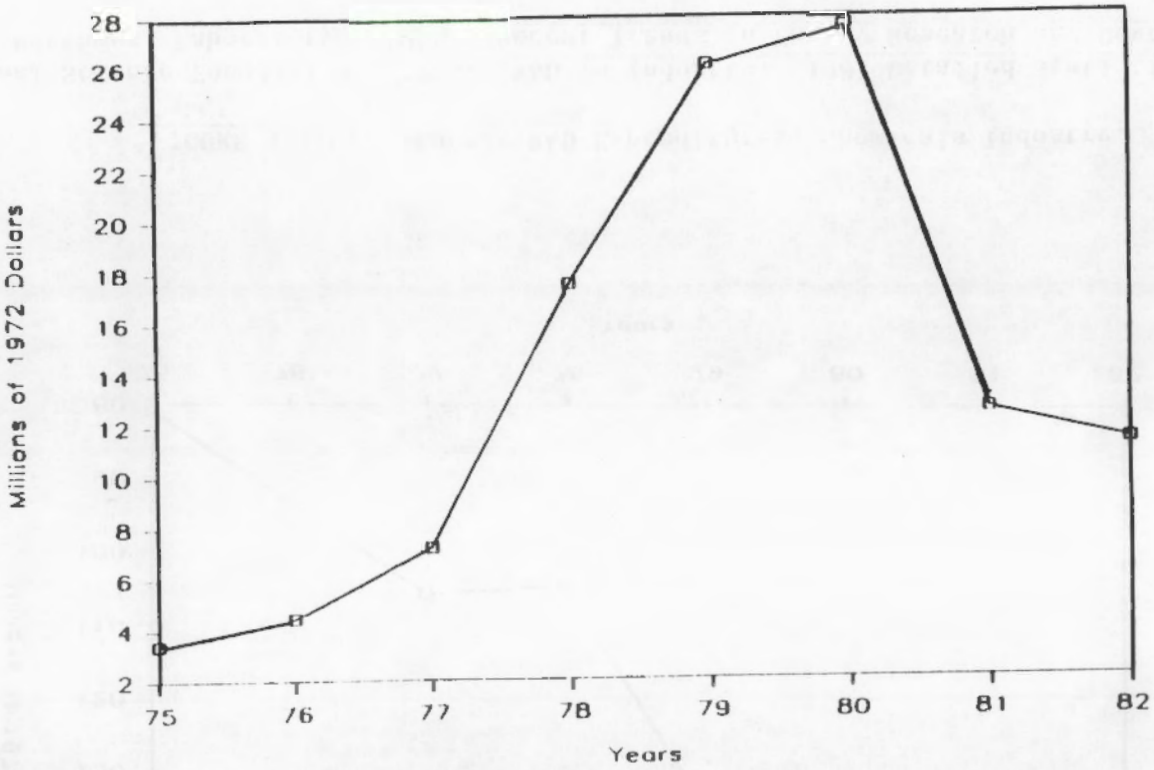

FIGURE 4.1(c). Energy Conservation R&D Expenditures, Chemicals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

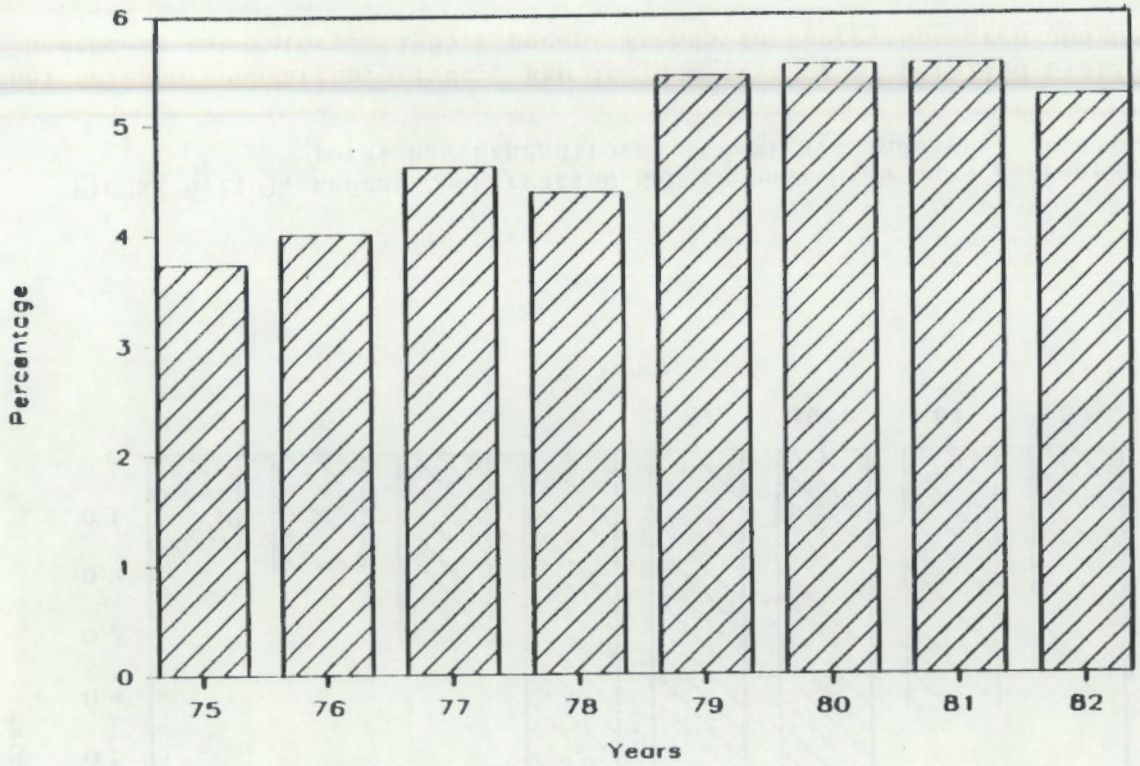

FIGURE 4.1(d). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, Chemicals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

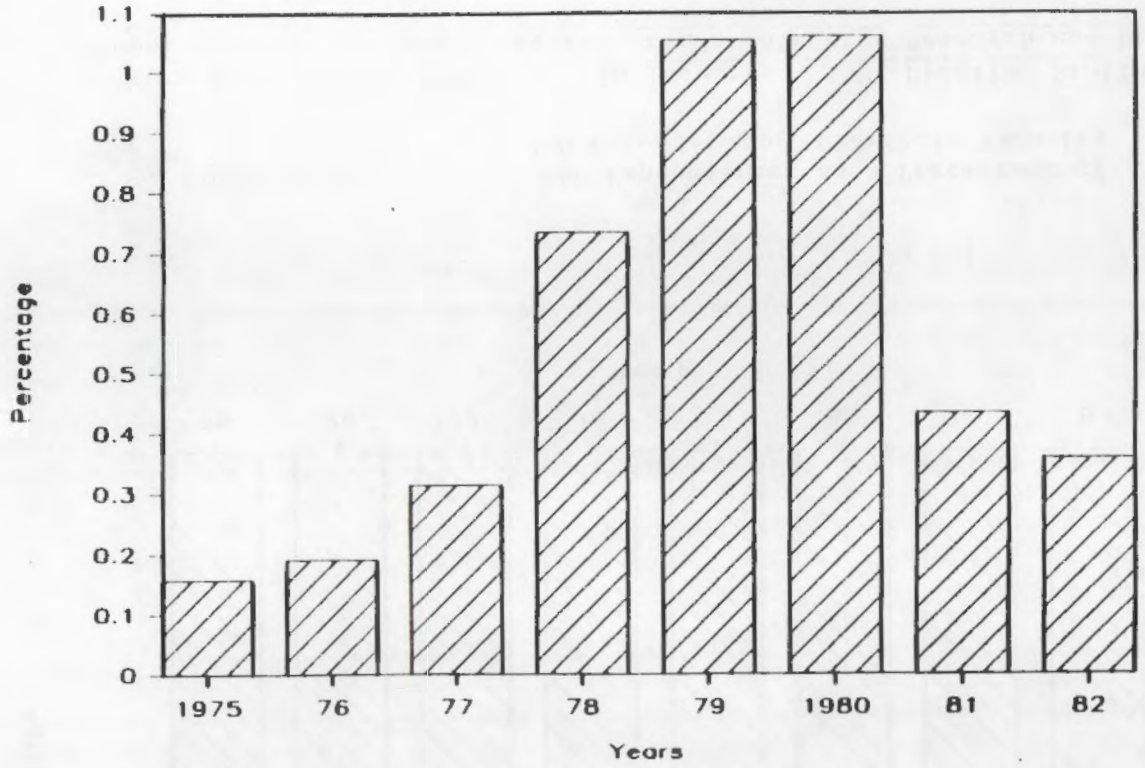

FIGURE 4.1(e). Energy Conservation R&D Expenditures as a Percentage of Total R&D Expenditures, Chemicals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

increased dramatically between 1975 and 1980 (from less than .2 percent to more than 1 percent) before falling back to .3 percent in 1982.

4.2 PETROLEUM INDUSTRY

Figures 4.2 (a) and (b) show real R&D expenditure trends for the Petroleum Industry (SIC 29). Real total R&D expenditures increased at an annual average rate of .076 during the 1975-1982 period, with accelerated increases in the 1977-1980 period, a slight decline in 1981, before an increase in 1982. As shown by Figure 4.2 (b), real energy R&D expenditure increases were fairly steady, at an annual average rate of .083, with a slight decline in expenditures in 1980.

Figure 4.2 (c) shows real energy R&D expenditures as a percentage of real total R&D expenditures. Energy's share of total R&D remained fairly constant at 60 percent during the 1975-1982 period, with a slight decline in 1980 to approximtely 55 percent of total.

4.3 PRIMARY METALS INDUSTRY

Figures 4.3 (a), (b), and (c) show real R&D expenditures trends for the Primary Metals Industry (SIC 33). Real total R&D expenditures increased at an annual average rate of .045 during the 1975-1982 period, with small decreases in 1977 and 1978, and large increases in the 1978-1982 period. As shown by Figure 4.3 (b), real energy R&D expenditures varied considerably in the 1975-1982 period, although they increased at an annual average rate of .122 for the entire period. Expenditures decreased slightly in 1978 and 1981, but substantially increased in the years 1977, 1979, and 1982. As shown by Figure 4.3 (c), real energy conservation R&D expenditures demonstrated remarkably different behavior from that of total and energy expenditures, increasing at an annual average rate of .204, with dramatic increases between 1975 and 1977, and substantial decreases between 1980 and 1982.

Figures 4.3 (d) and (e) show real energy and energy conservation R&D expenditures as a percentage of real total R&D expenditures for the industry. Energy's share of total R&D expenditures varied during the 1975-1982 period, dipping to 6 percent of total in 1975 and increasing to more than 11 percent of total in 1979, before falling slightly in the

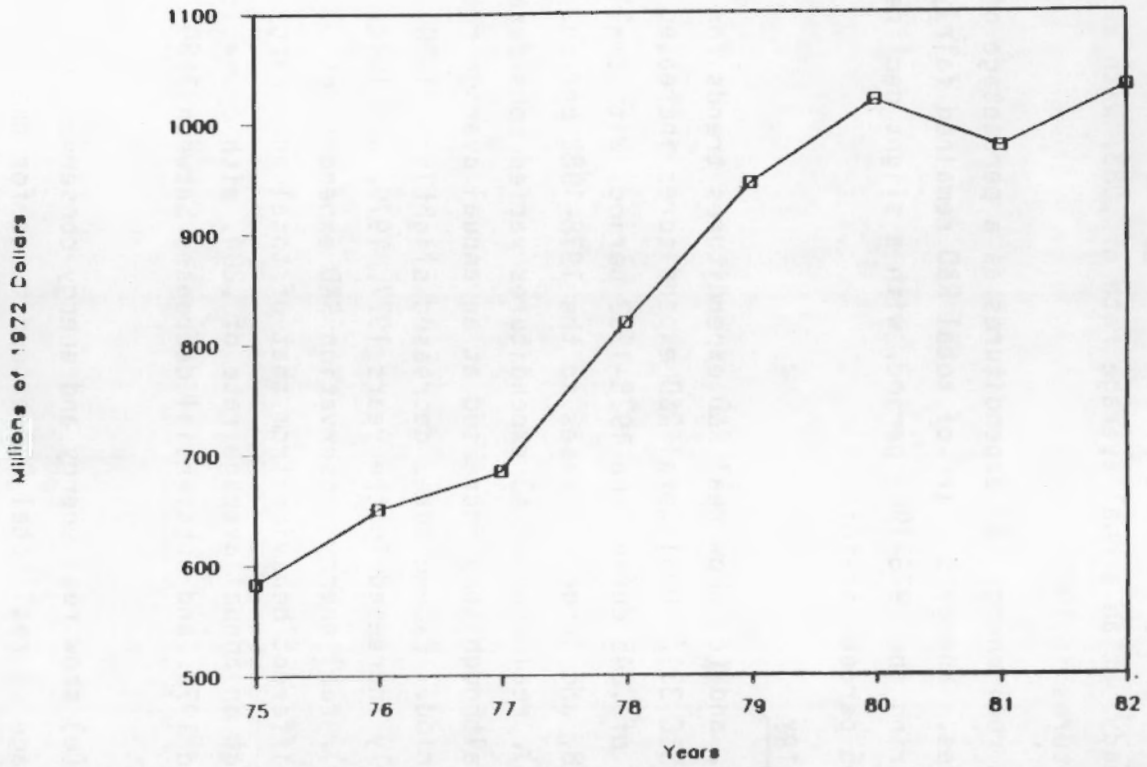

FIGURE 4.2(a). Total R&D Expenditures, Petroleum Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

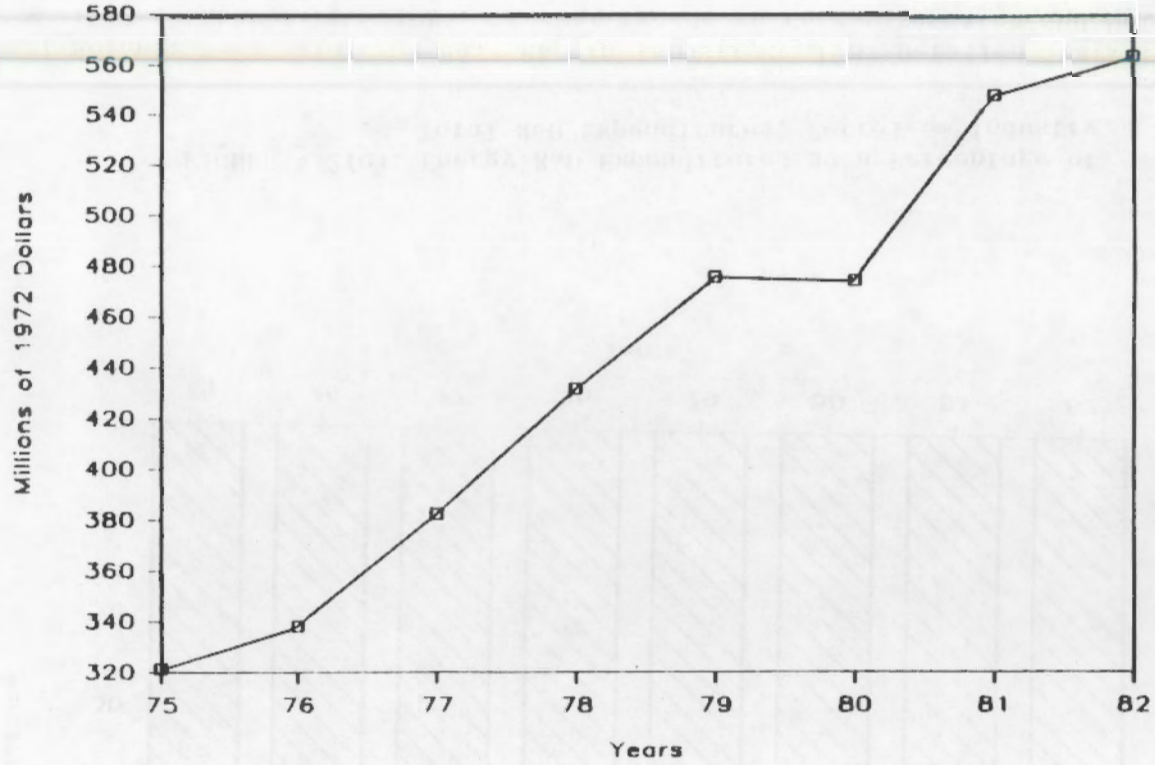

FIGURE 4.2(b). Energy R&D Expenditures, Petroleum Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

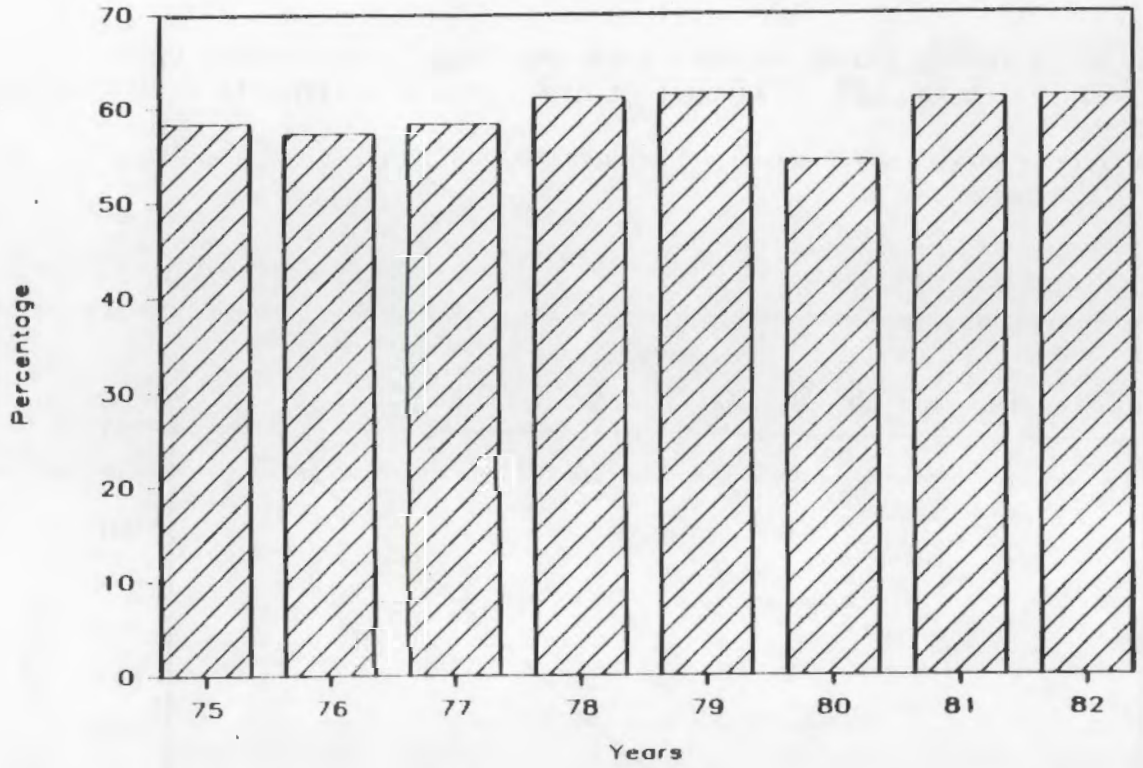

FIGURE 4.2(c). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, Petroleum Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

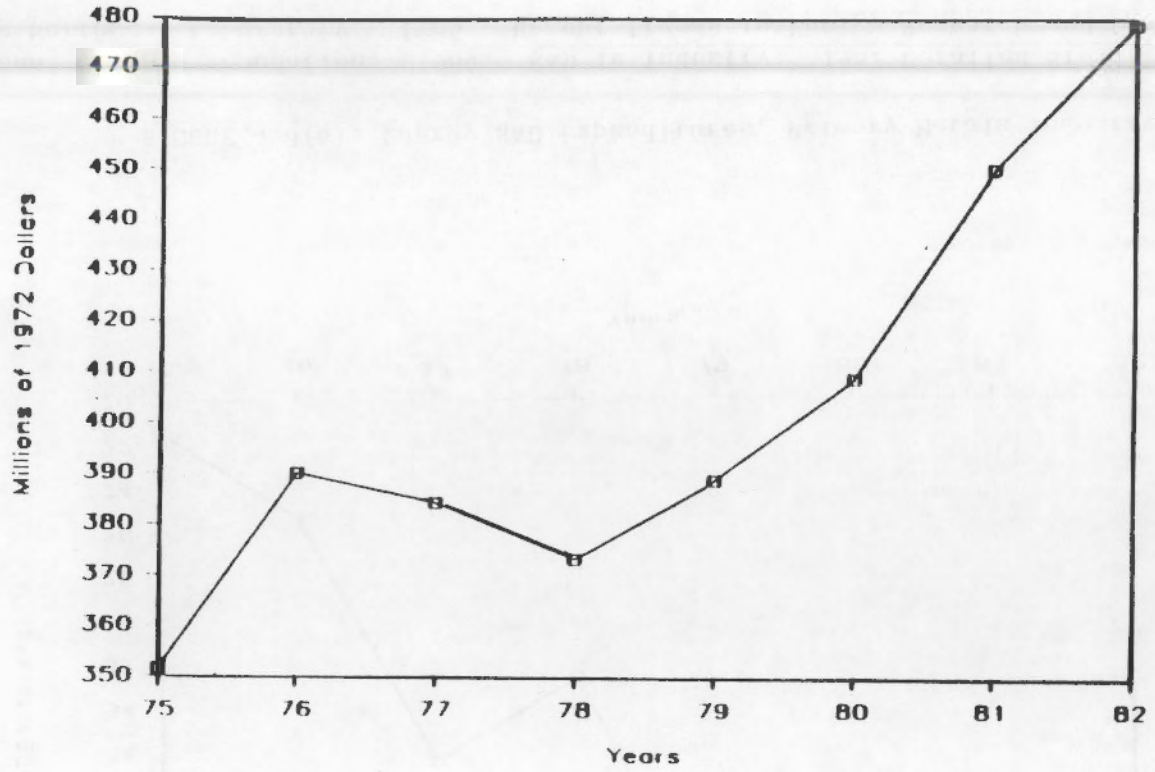

FIGURE 4.3(a). Total R&D Expenditures, Primary Metals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

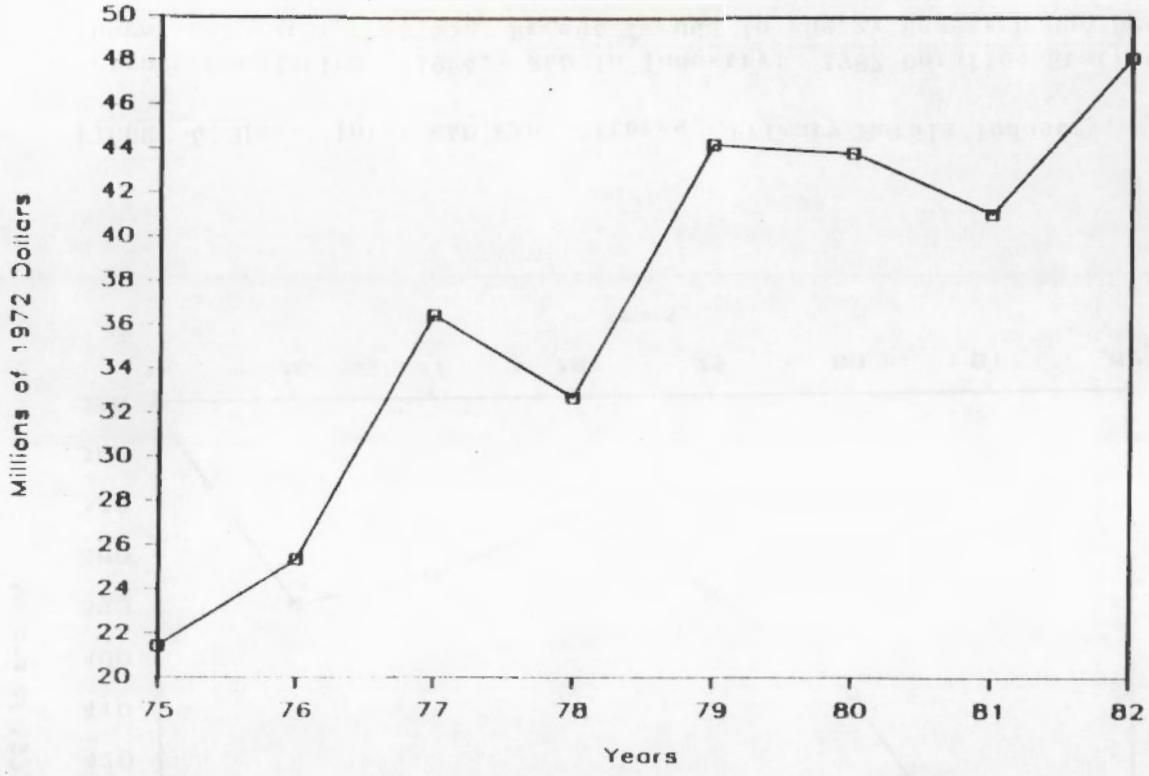

FIGURE 4.3(b). Energy R&D Expenditures, Primary Metals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

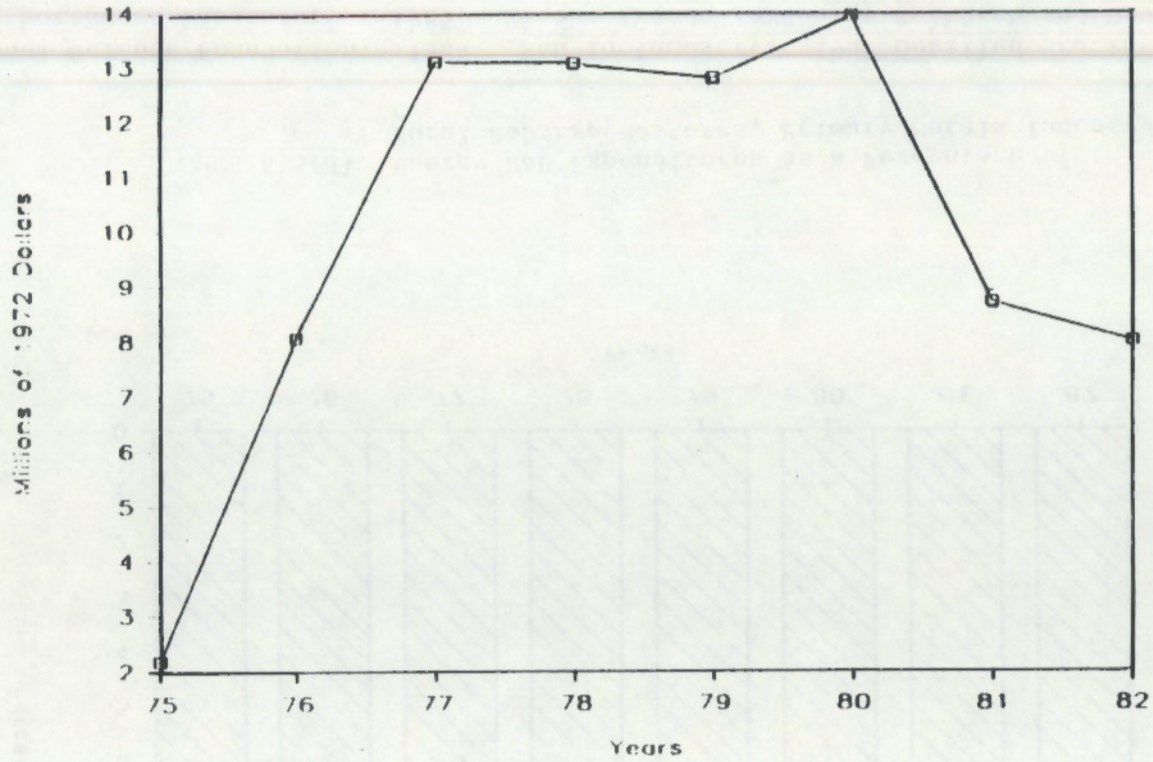

FIGURE 4.3(c). Energy Conservation R&D Expenditures, Primary Metals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

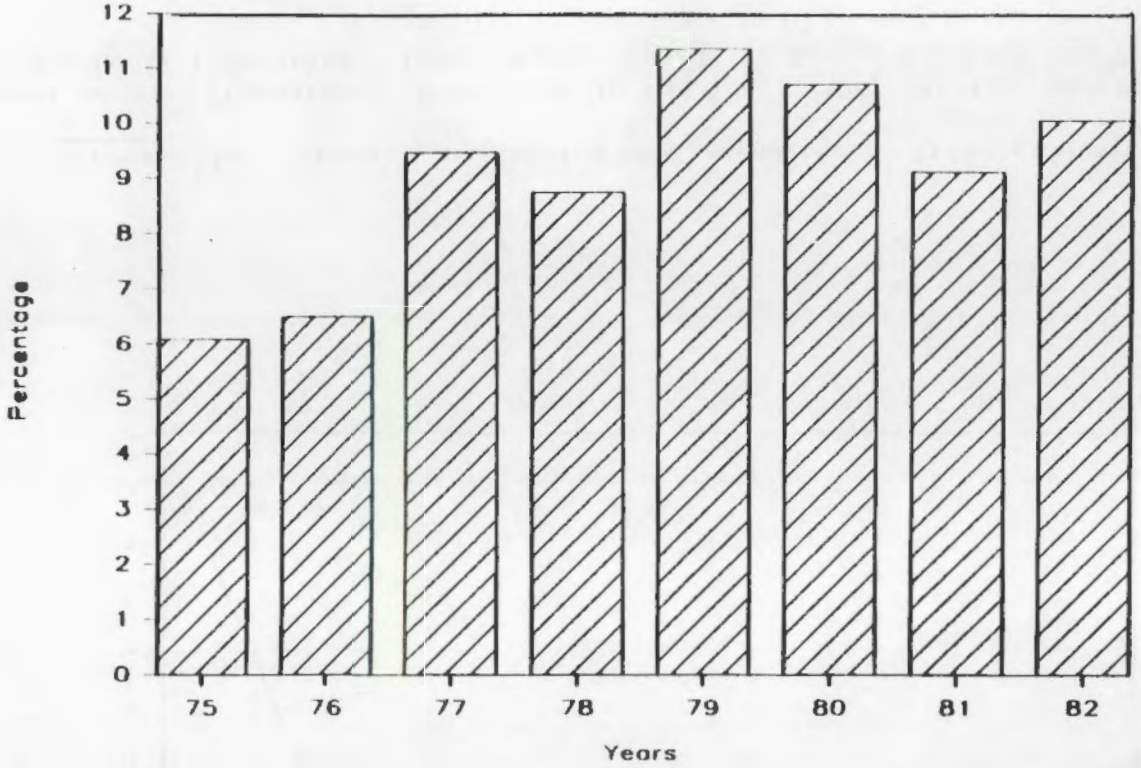

FIGURE 4.3(d). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, Primary Metals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

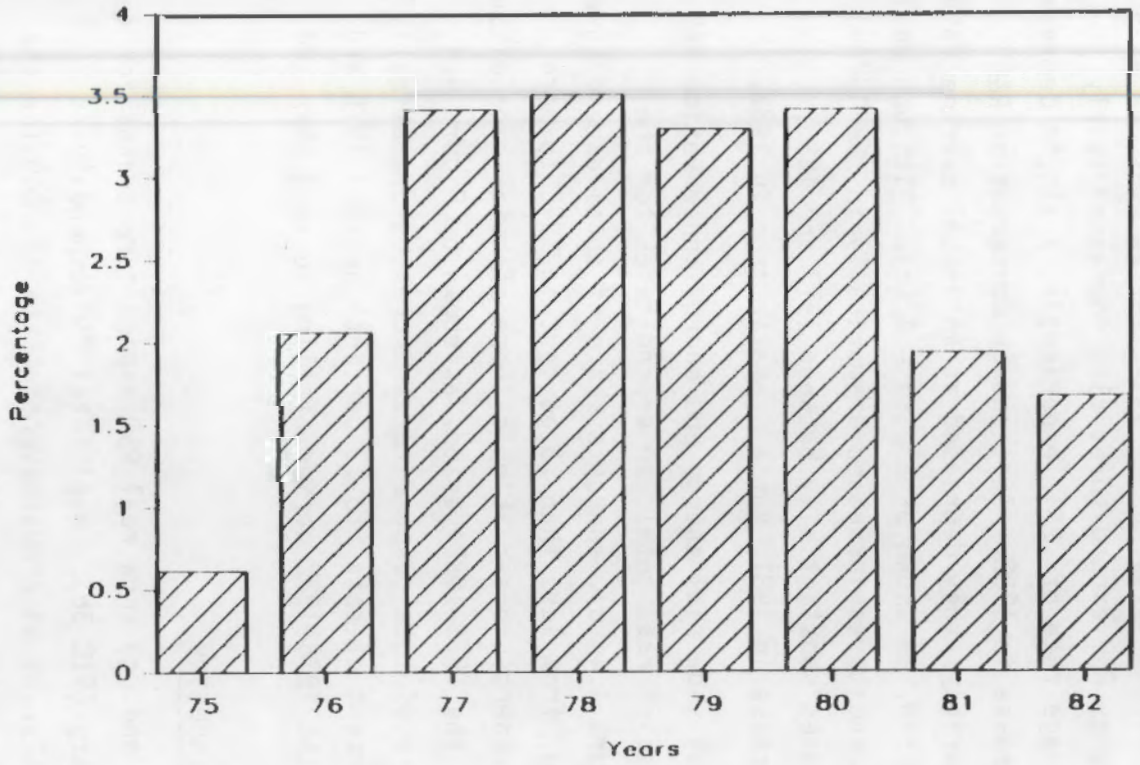

FIGURE 4.3(e). Energy Conservation R&D Expenditures as a Percentage of Total R&D Expenditures, Primary Metals Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

1980-1982 period. As shown by Figure 4.3 (e), energy conservation's share increased in the period between 1975 and 1978 to approximately 3.5 percent of total, then declined to approximately 1.8 percent in 1982.

4.4 MACHINERY INDUSTRY

Figures 4.4 (a), (b), and (c) show real R&D expenditure trends for the Machinery Industry (SIC 35). Real total R&D expenditures grew at a fairly steady rate between 1975 and 1982, at an annual average rate of 0.58, with an accelerated increase in expenditures in the 1979-1982 period. As shown by Figure 4.4 (b), real energy R&D expenditures also increased fairly steadily, at an annual average rate of .261, experiencing a slight decrease in 1979 and a dramatic increase in 1982. Real energy conservation R&D expenditures varied considerably; they decreased at an annual average rate of -.023 for the entire period, as shown by Figure 4.4 (c). Although real energy conservation R&D expenditures increased dramatically in the 1975-1977 period, expenditures decreased substantially between 1977 and 1980, demonstrating a slight increase in 1981, but a dramatic drop in 1982.

Figures 4.4 (d) and (e) show real energy and energy conservation R&D expenditures as a percentage of real total R&D expenditures for the industry. As shown by Figure 4.4 (d), energy's share of total expenditures increased during the period, from less than .8 percent in 1975 to more than 2.4 percent in 1982. Energy conservation's share of total expenditures varied considerably during the 1975-1982 period, as shown by Figure 4.4 (e). The conservation share of total expenditures increased dramatically (from approximately .05 percent of total to .3 percent) between 1975 and 1977 before decreasing in the 1978-1982 period, falling to less than .04 percent in 1982.

4.5 ELECTRICAL EQUIPMENT INDUSTRY

Figures 4.5 (a), (b), and (c) show real R&D expenditure trends for the Electrical Equipment Industry (SIC 36). Real total R&D expenditures increased fairly consistently, at an annual average rate of .049 for the entire period, declining slightly only in 1977. As shown by Figure 4.5 (b), real energy R&D expenditures varied considerably during the period, although they increased at an annual average rate of .017 for the

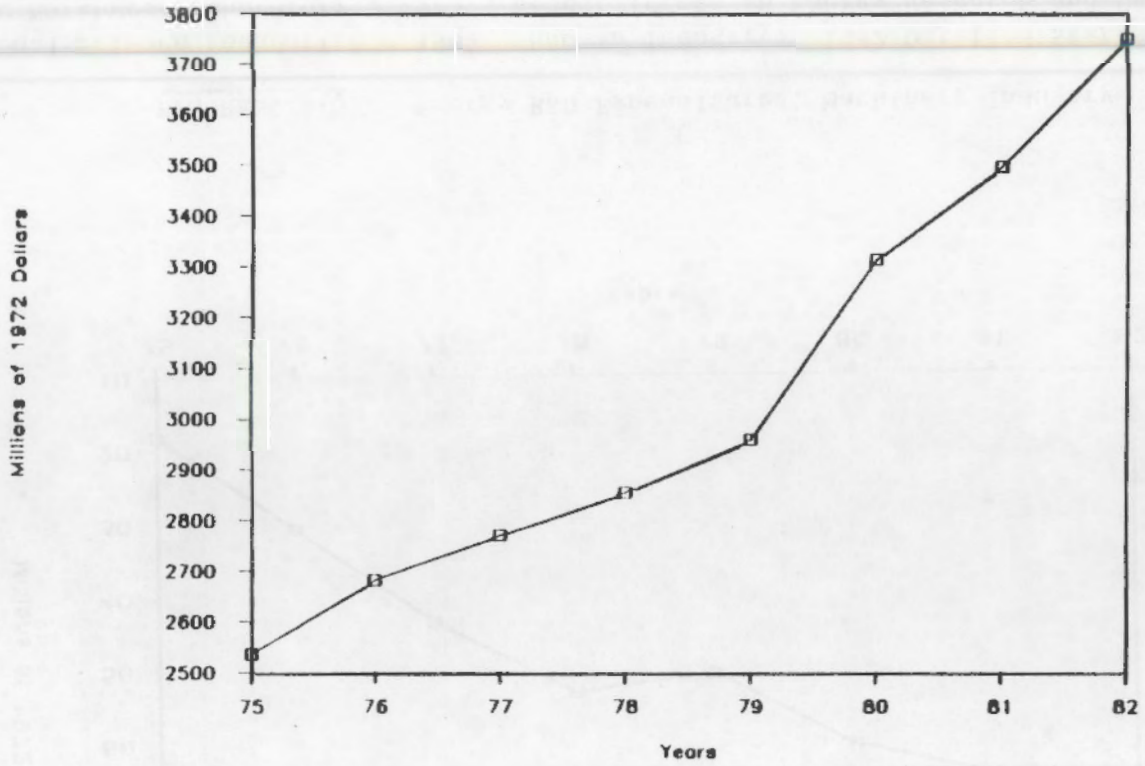

FIGURE 4.4(a). Total R&D Expenditures, Machinery Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

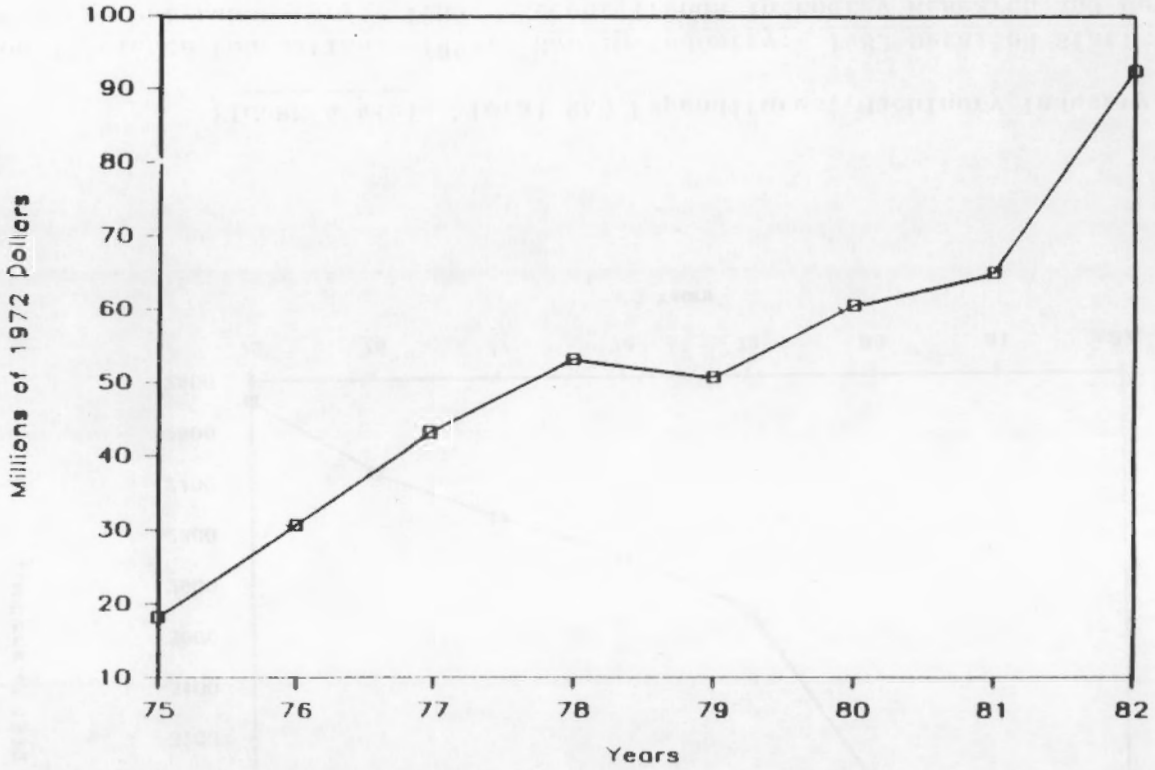

FIGURE 4.4(b). Energy R&D Expenditures, Machinery Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

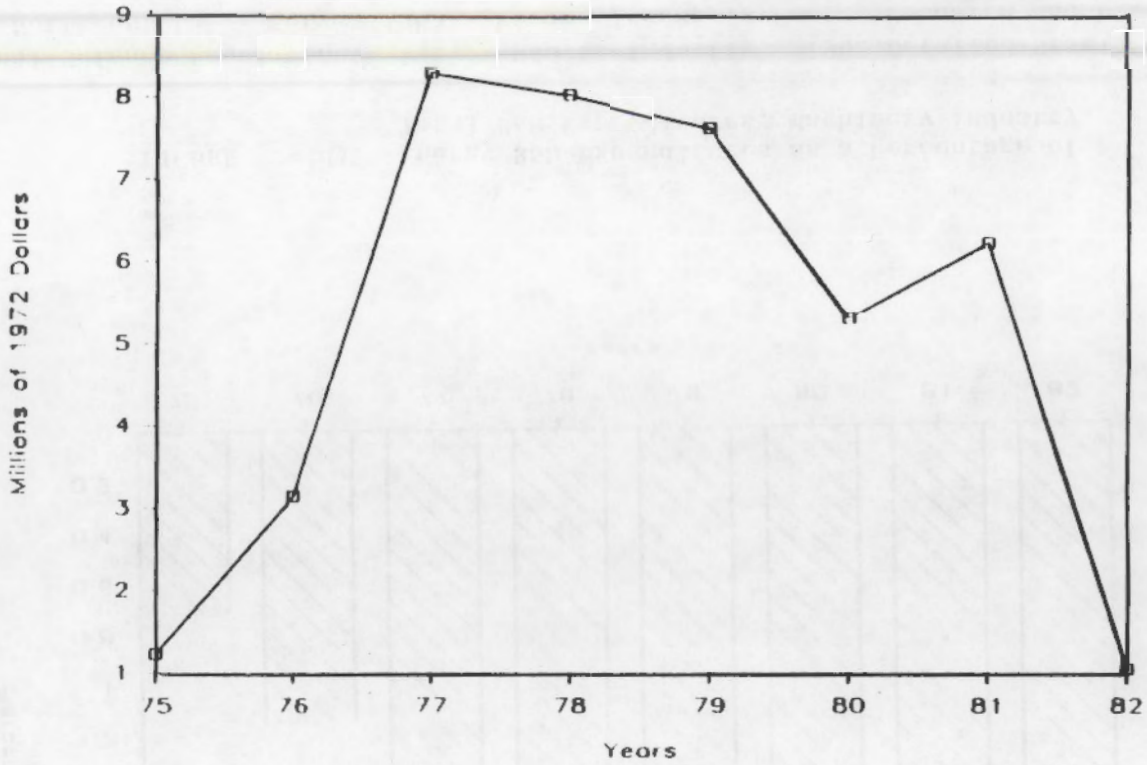

FIGURE 4.4(c). Energy Conservation R&D Expenditures, Machinery Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

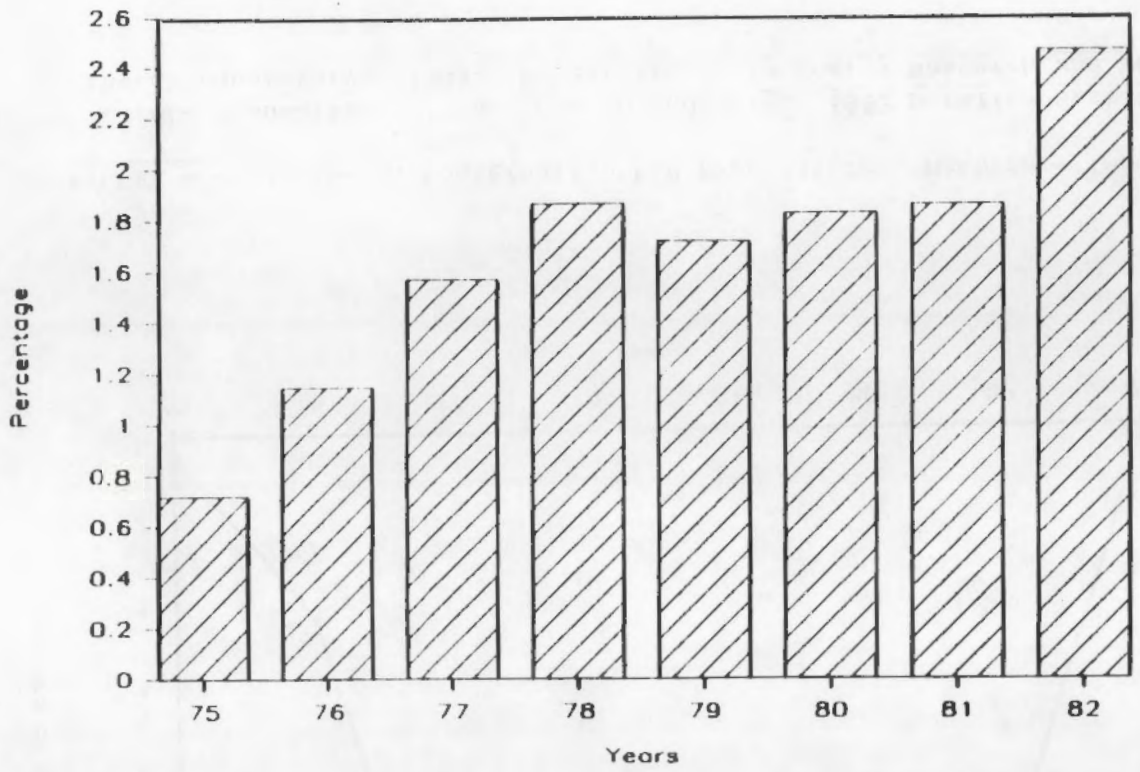

FIGURE 4.4(d). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, Machinery Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

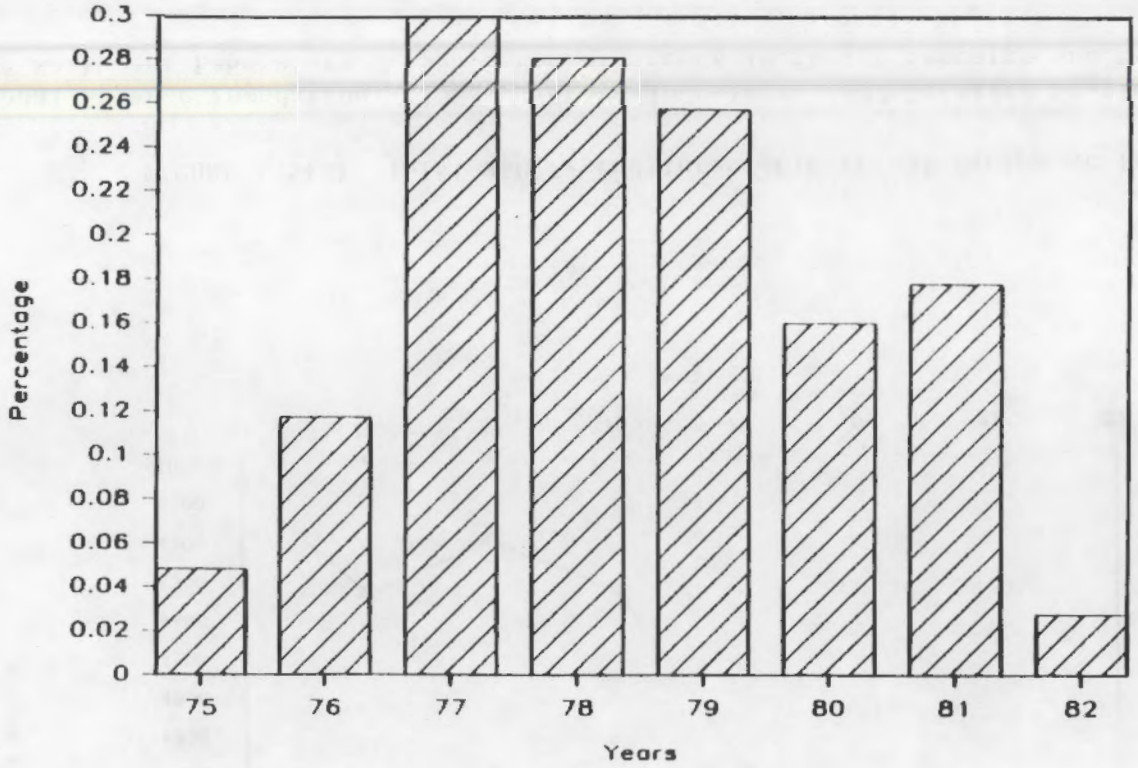

FIGURE 4.4(e). Energy Conservation R&D Expenditures as a Percentage of Total R&D Expenditures, Machinery Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

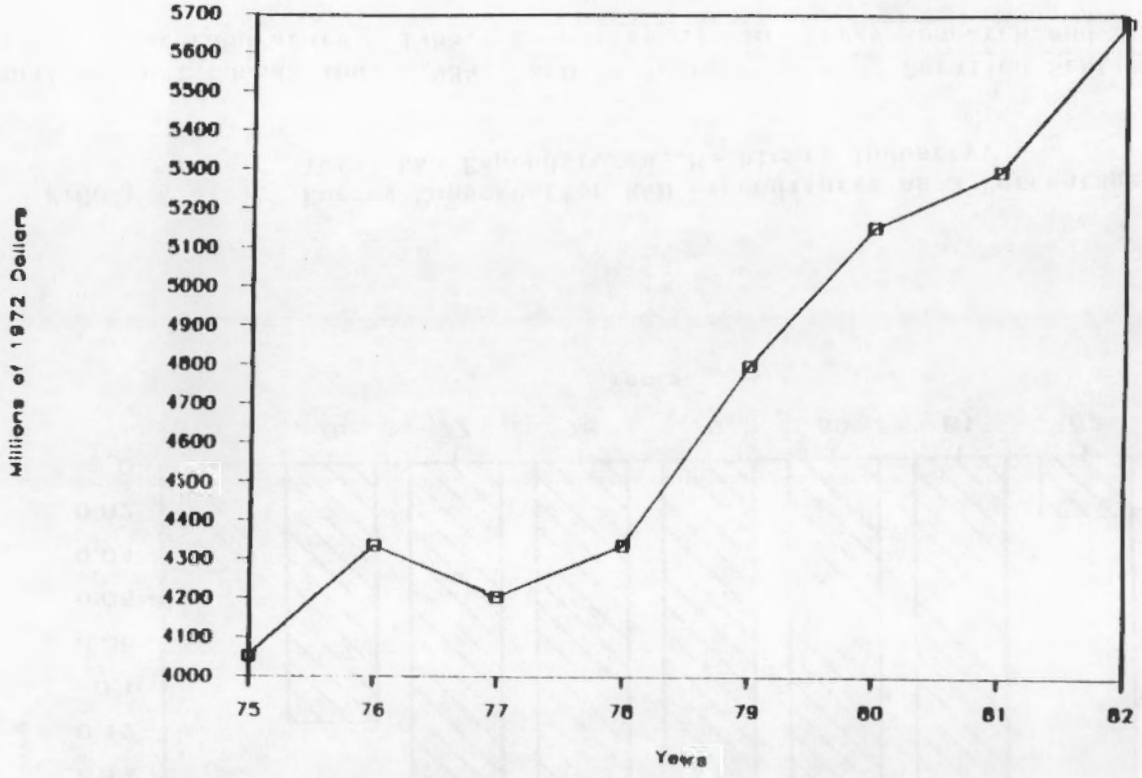

FIGURE 4.5(a). Total R&D Expenditures, Electrical Equipment Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

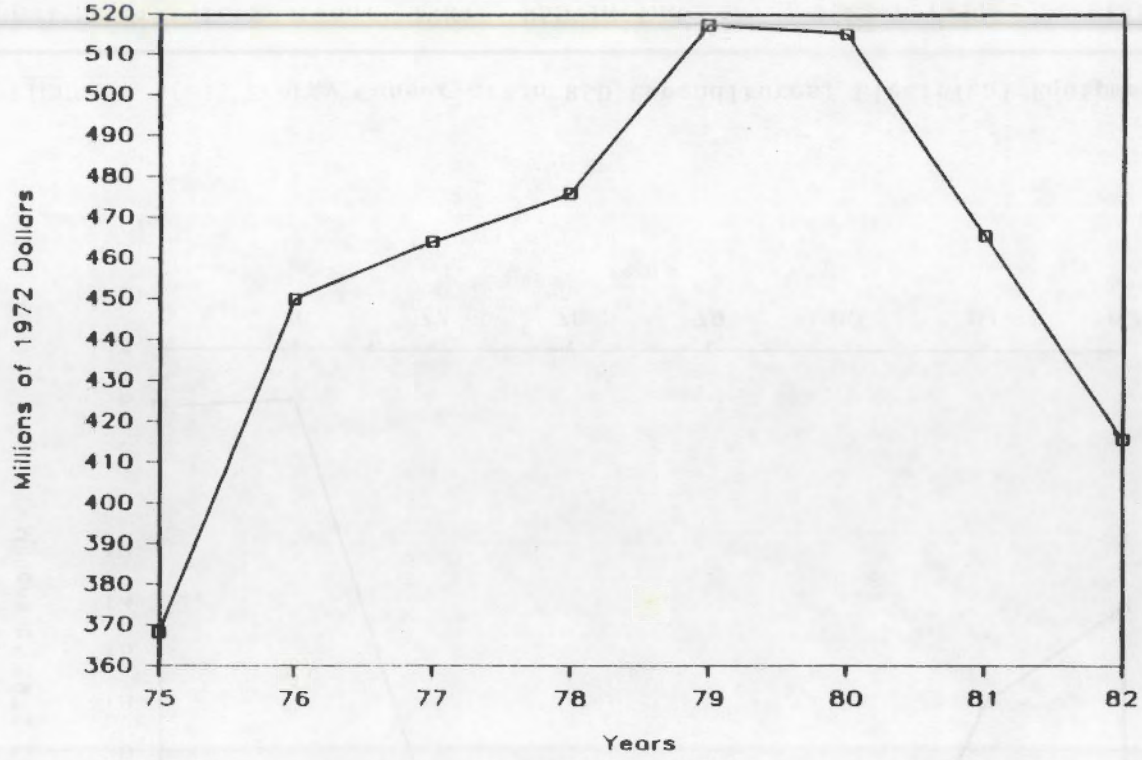

FIGURE 4.5(b). Energy R&D Expenditures, Electrical Equipment Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

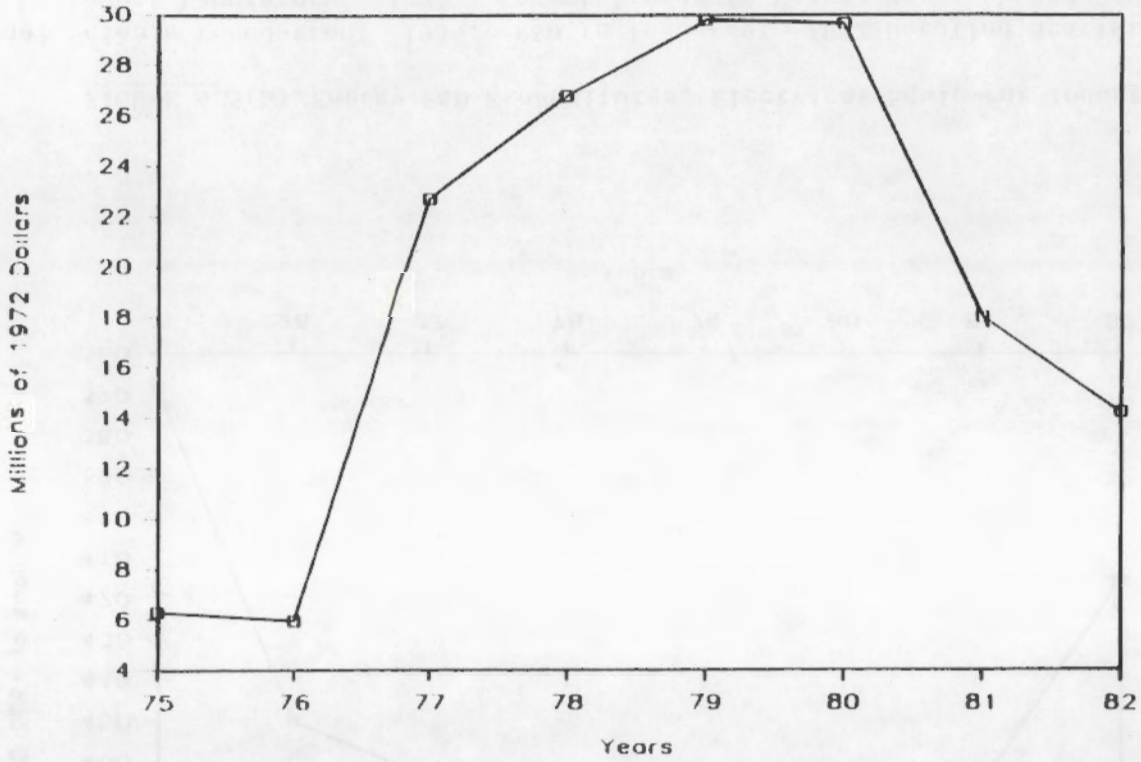

FIGURE 4.5(c). Energy Conservation R&D Expenditures, Electrical Equipment Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

period as a whole. Substantial increases occurred during the 1975-1979 period, but very large decreases took place during the 1980-1982 period. Similarily, real energy conservation R&D expenditures varied during the 1975-1982 period, as shown by Figure 4.5 (c). For the period as a whole, expenditures increased at an average annual rate of .124. However, expenditures increased at a considerably higher rate between 1976 and 1979, before declining substantially between 1980 and 1982.

Figures 4.5 (d) and (e) show real energy and energy conservation R&D expenditures as a percentage of real total R&D expenditures. As shown by Figure 4.5 (d), energy's share of total was highest in the period between 1977 and 1979 at approximately 11 percent; it declined between 1979 and 1982, falling to less than 8 percent in 1982. Similarily, as shown by Figure 4.5(e), energy conservation's share increased dramatically in 1977, from less than .2 percent to more than .5 percent, then decreased almost as dramatically between 1980 and 1982.

4.6 AIRCRAFT AND MISSILE INDUSTRY

Figures 4.6 (a) and (b) show real R&D expenditure trends for the Aircraft and Missile Industry (SICs 372 and 376). Real total R&D expenditures increased at an annual average rate of .057, with a slight decline in 1979, followed by large increases in 1981 and 1982. As shown by Figure 4.6 (b), real energy R&D expenditures increased at an annual average rate of .067, increasing substantially between 1976 and 1980, before decreasing in 1981 and 1982.

Figure 4.6 (c) shows real energy R&D expenditures as a percentage of real total R&D expenditures. Energy's share of total increased substantially in the period between 1976 and 1980, from less than 2 percent to almost 5 percent, before falling back to approximately 2 percent in 1982.

4.7 PROFESSIONAL AND SCIENTIFIC INSTRUMENTS INDUSTRY

Figures 4.7 (a) and (b) show real R&D expenditure trends for the Professional and Scientific Instruments Industry (SIC 38). Real total R&D expenditures consistently increased between 1975 and 1982, at an annual average rate of .11. As shown by Figure 4.7 (b), real energy R&D expenditures varied tremendously between 1975 and 1982, but for the entire period

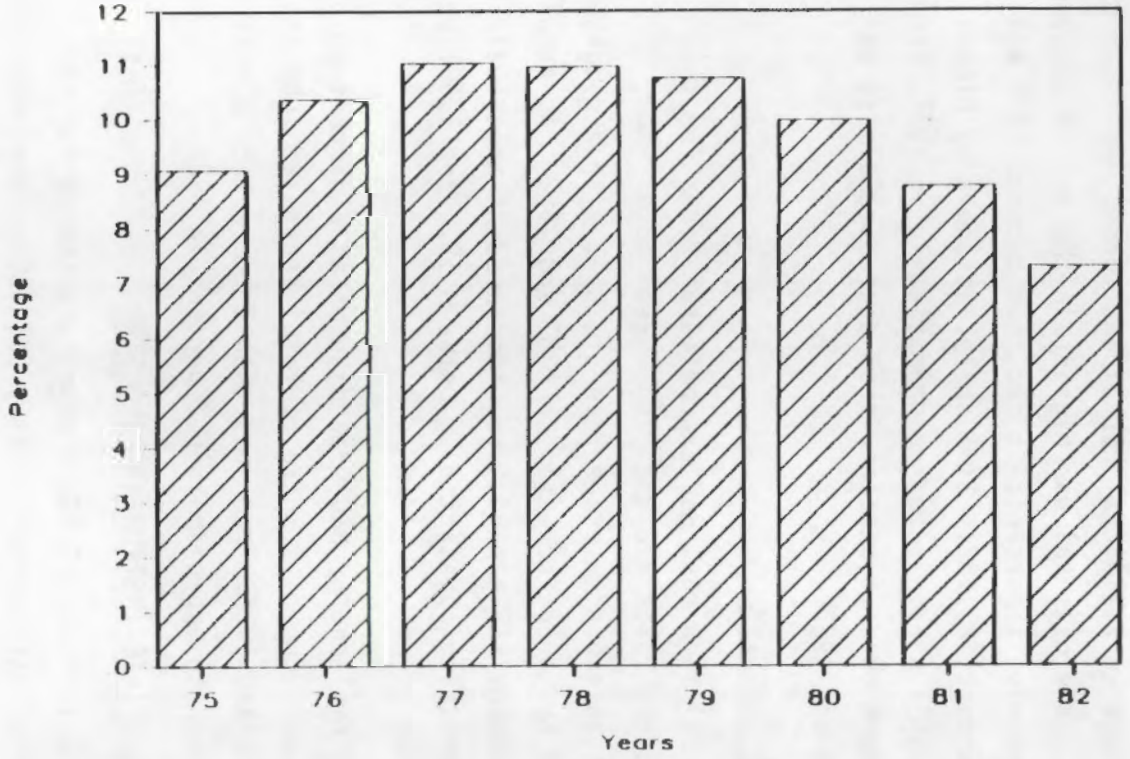

FIGURE 4.5(d). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, Electrical Equipment Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

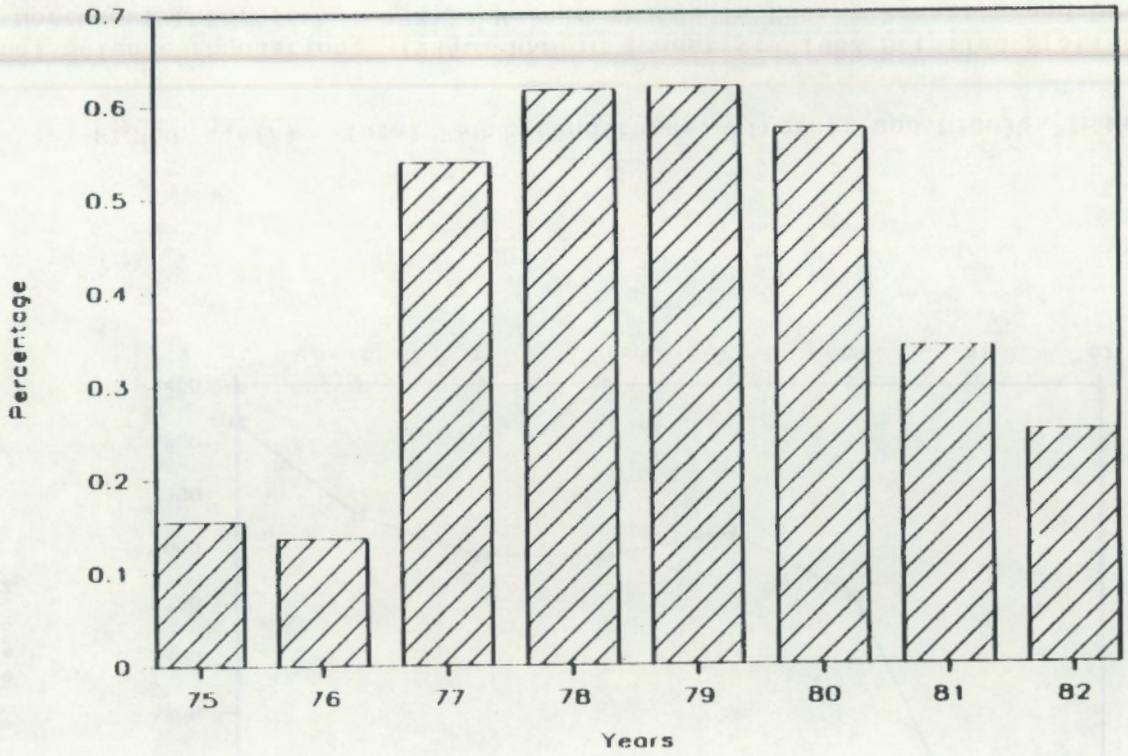

FIGURE 4.5(e). Energy Conservation R&D Expenditures as a Percentage of Total R&D Expenditures, Electrical Equipment Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

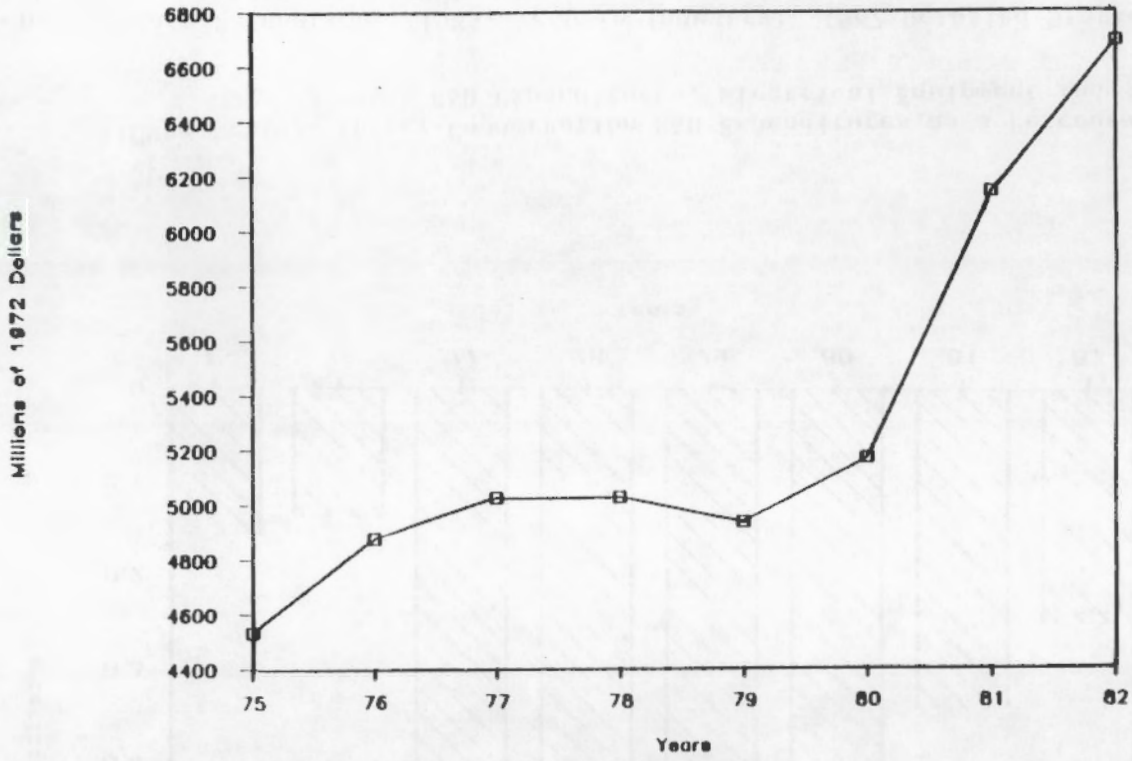

FIGURE 4.6(a). Total R&D Expenditures, Aircraft and Missles Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

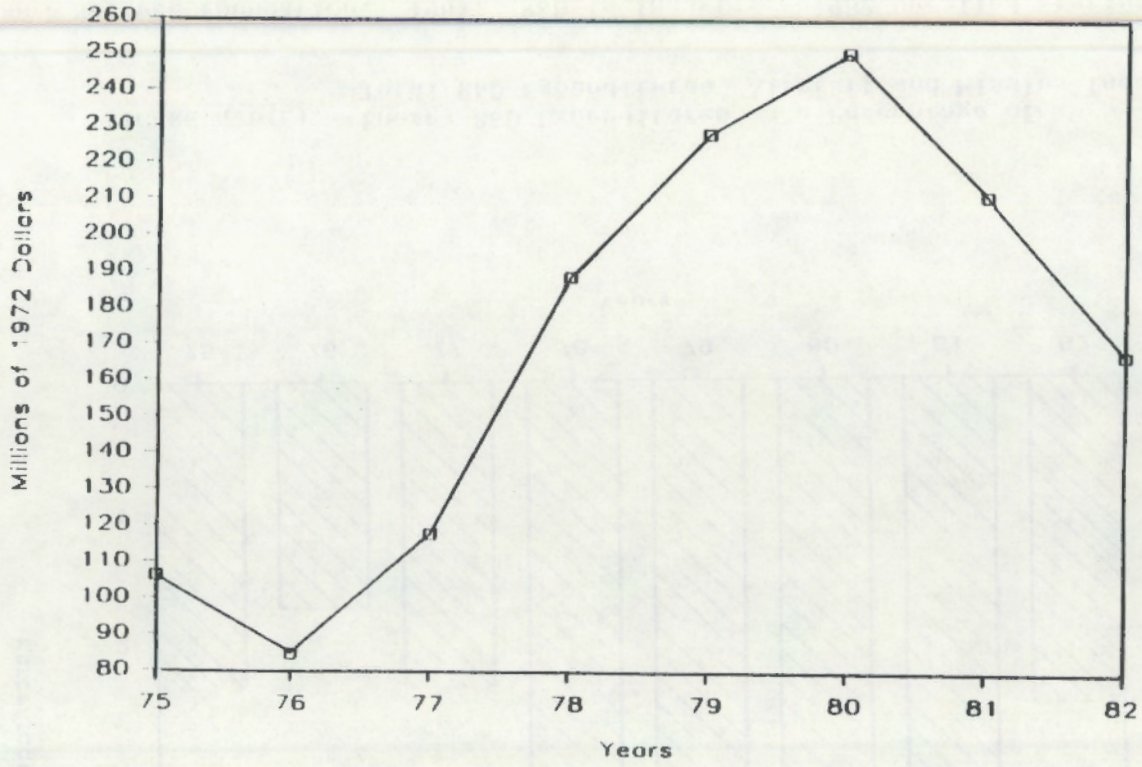

FIGURE 4.6(b). Energy R&D Expenditures. Aircraft and Missles Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

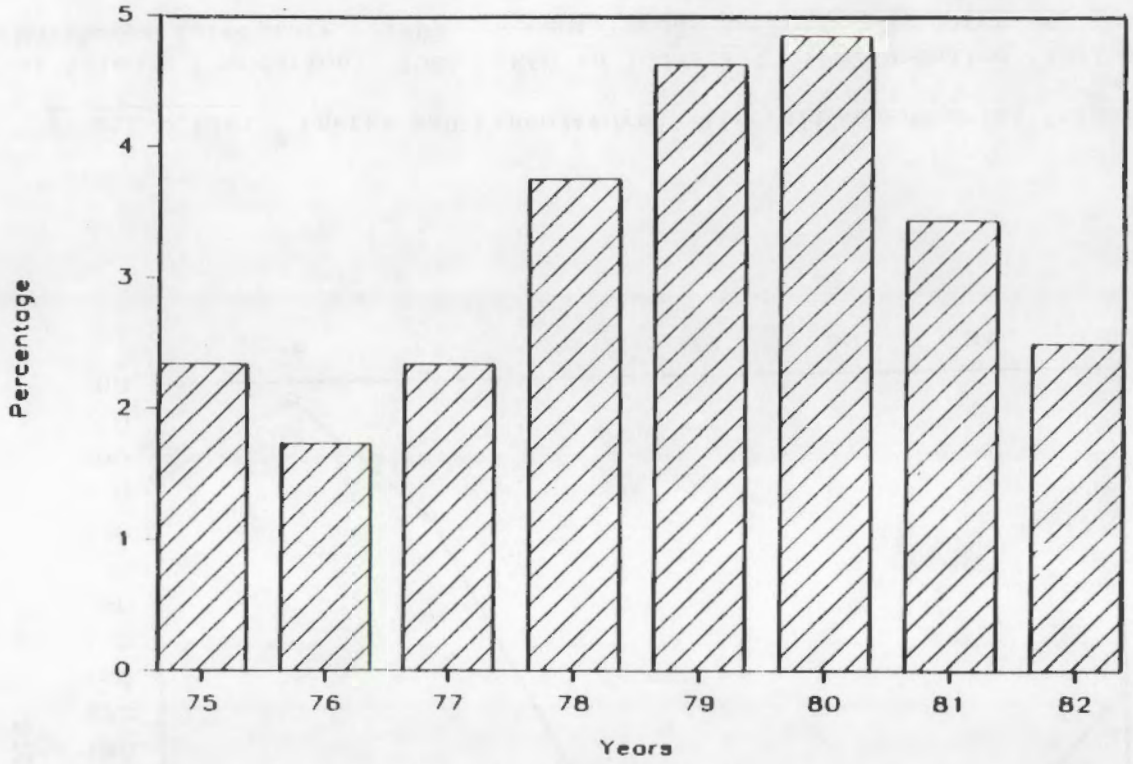

FIGURE 4.6(c). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, Aircraft and Missles Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

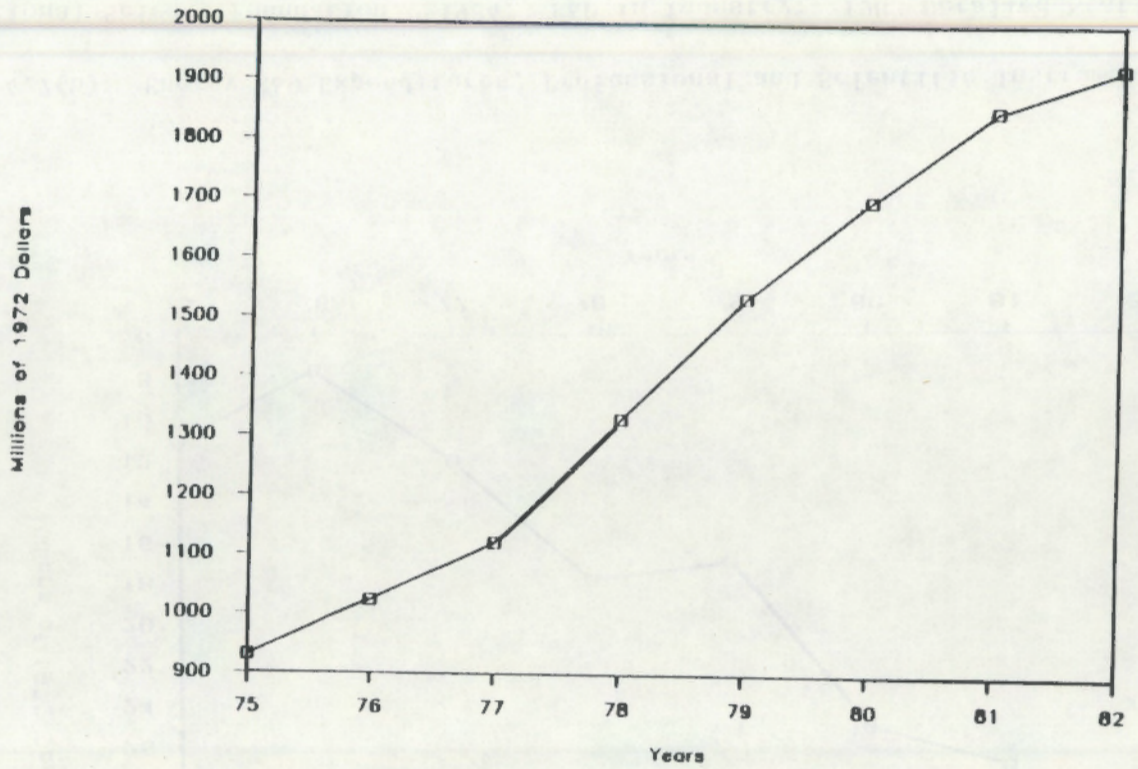

FIGURE 4.7(a). Total R&D Expenditures, Professional and Scientific Instruments Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

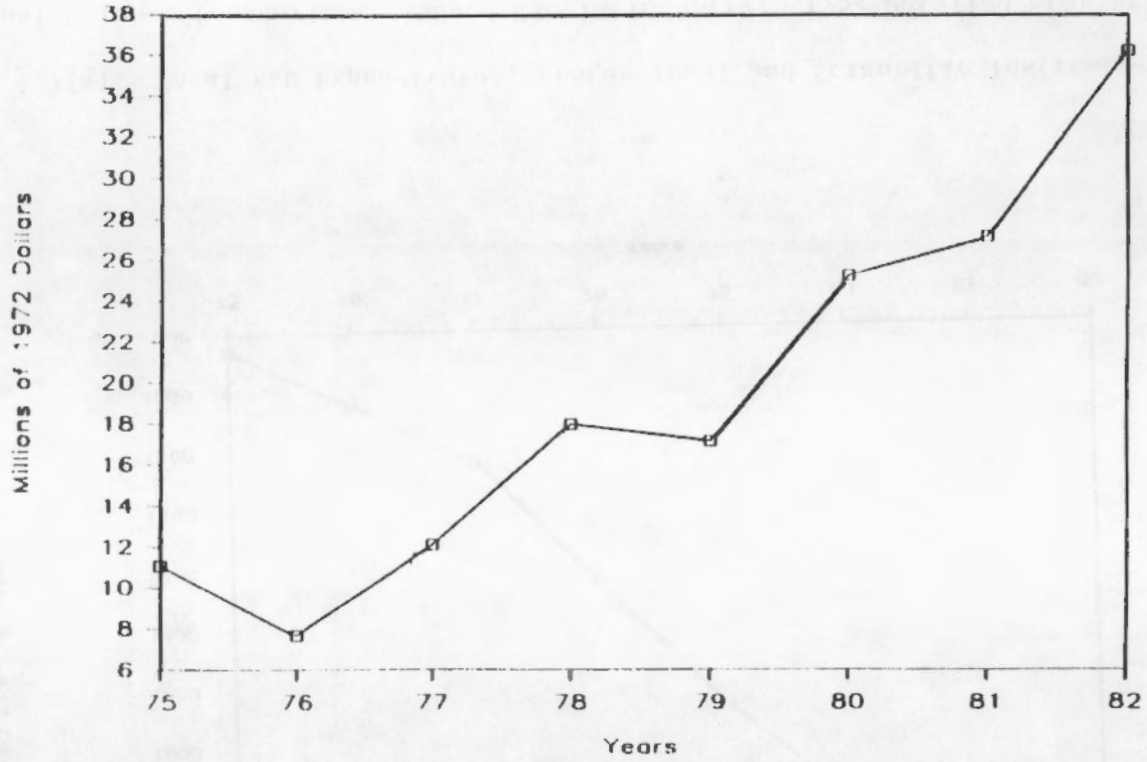

FIGURE 4.7(b). Energy R&D Expenditures, Professional and Scientific Instruments Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

increased at an annual average rate of .184.

Figure 4.7 (c) shows real energy R&D expenditures as a percentage of real total R&D expenditures. Energy's percentage of total varied in the period between 1975 and 1982, with energy's share of total equal to .7 percent in 1976 and approximately 1.9 percent in 1982.

4.8 OTHER MANUFACTURING INDUSTRIES

Figures 4.8 (a), (b), and (c) show real R&D expenditure trends for Other Manufacturing Industries. Real total R&D expenditures increased at an annual average rate of .036 for the entire period, increasing substantially between 1975 and 1980, before falling in 1981 and 1982. As shown by Figure 4.8 (b), real energy R&D expenditures varied considerably during the 1975-1982 period, increasing at an annual average rate of .002. Expenditures increased dramatically in the 1975-1980 period, with a slight decline in 1978, followed by dramatic decreases in 1981 and 1982. Following a similiar pattern, as shown by Figure 4.8 (c), real energy conservation R&D expenditures increased at an average annual rate of .074. Real energy conservation R&D expenditures peaked in 1978, and decreased substantially in the period between 1978 and 1982.

Figures 4.8 (d) and (e) show real energy and energy conservation R&D expenditures as a percentage of real total R&D expenditures for the industry. Energy's share of total remained fairly constant between 1975 and 1980, but decreased in 1981 and 1982. As shown by Figure 4.8 (e), energy conservation's share of total increased between 1977 and 1979, peaking in 1979 at 2.6 percent, before falling to less than 1 percent in 1982.

4.9 NONMANUFACTURING INDUSTRIES

Figures 4.9 (a), (b), and (c) show real R&D expenditure trends for all Nonmanufacturing Industries. Real total R&D increased consistently in the 1975-1982 period, at an annual average rate of .085. Real expenditures declined only in 1981. As shown by Figure 4.9 (b), real energy expenditures increased at an annual average rate of .127 for the entire period, increasing dramatically in the period between 1975 and 1979, before falling off slightly in the 1980-1982 period. Similarly, as shown by Figure 4.9 (c), real energy conservation R&D expenditures increased at an annual average rate of .26

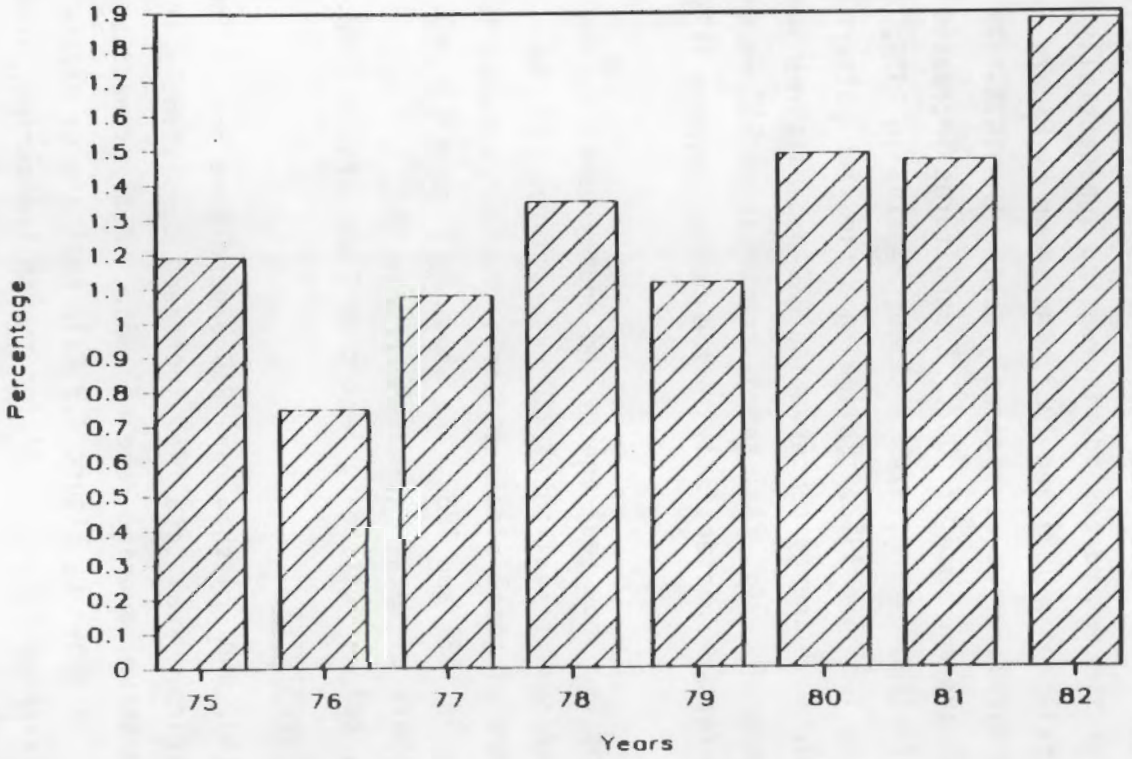

FIGURE 4.7(c). Energy R&D Expenditures as a Percentage of Total R&D Expenditures. Professional and Scientific Instruments Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

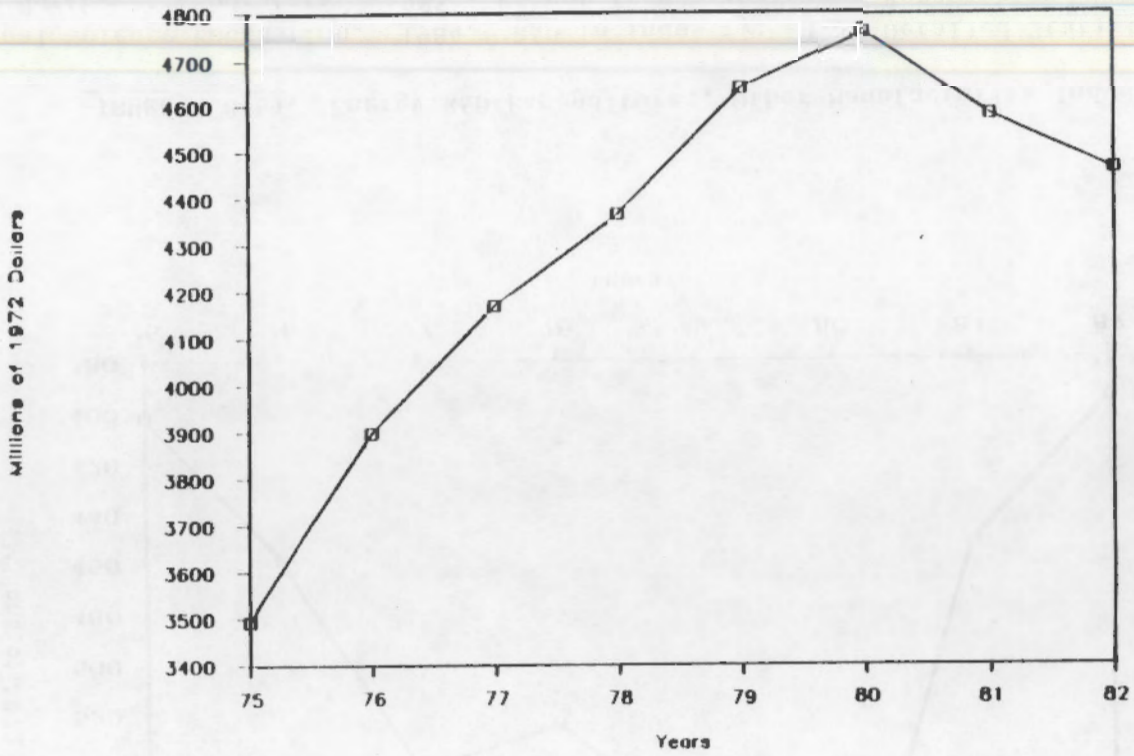

FIGURE 4.8(a). Total R&D Expenditures, Other Manufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

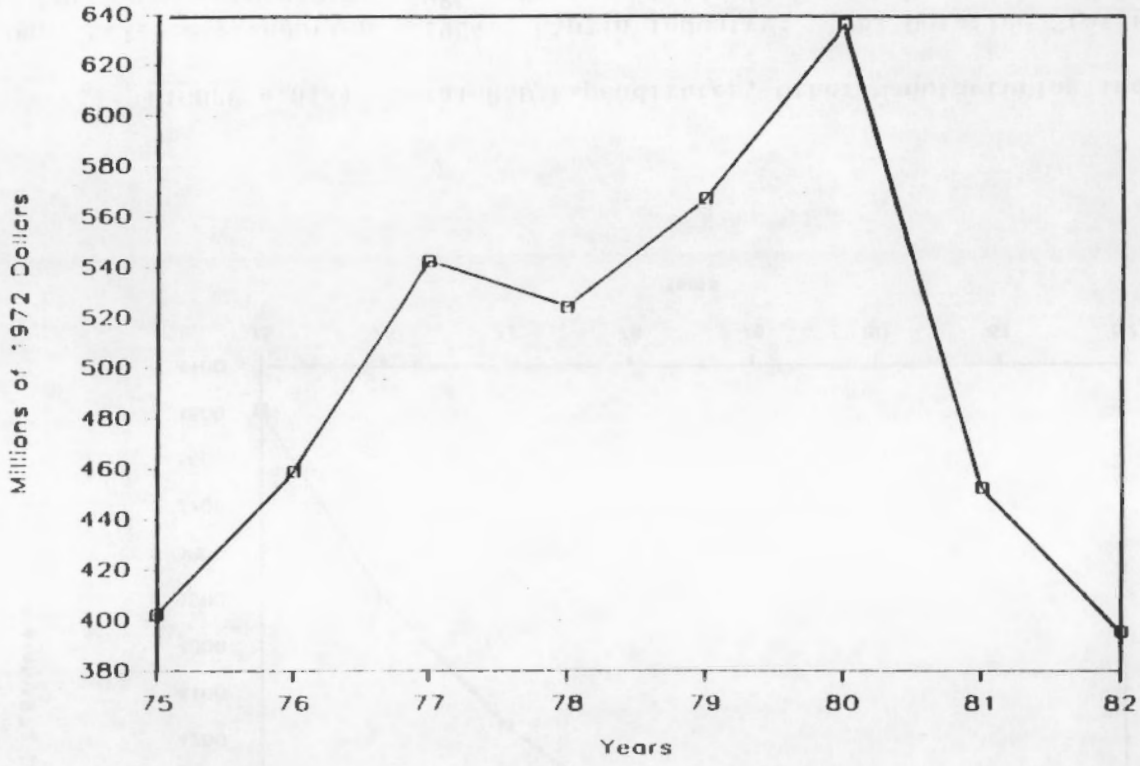

FIGURE 4.8(b). Energy R&D Expenditures, Other Manufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

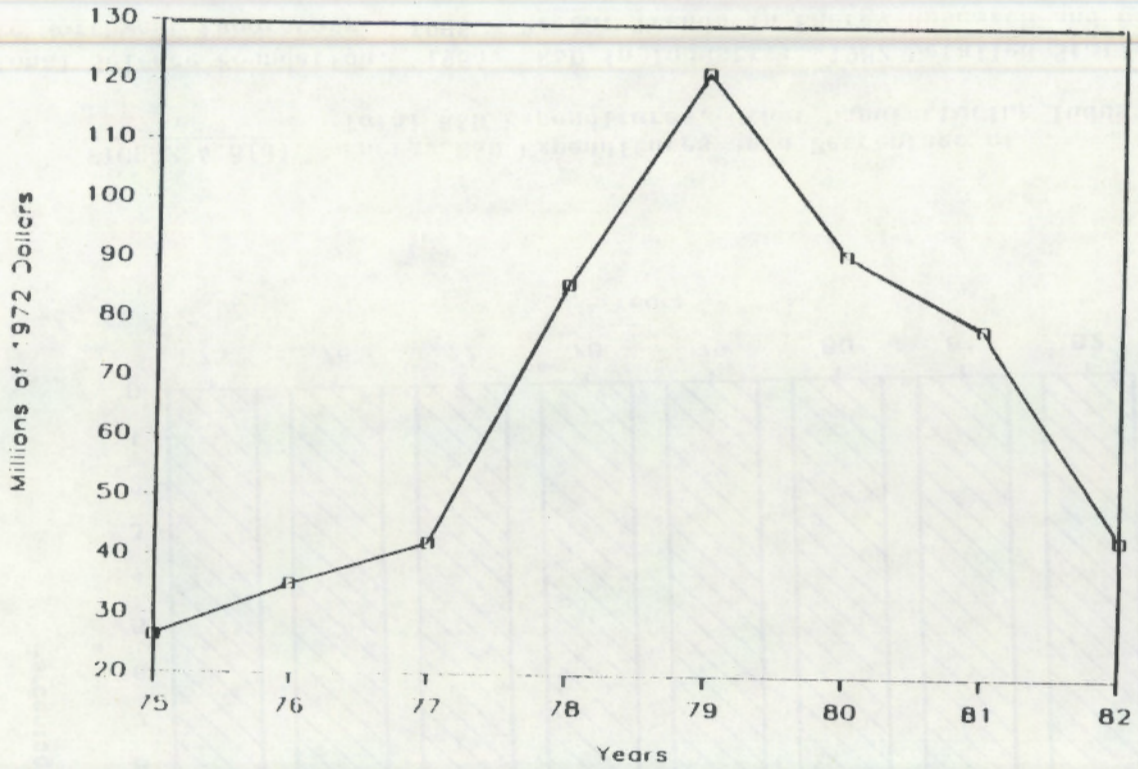

FIGURE 4.8(c). Energy Conservation R&D Expenditures, Other Manufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

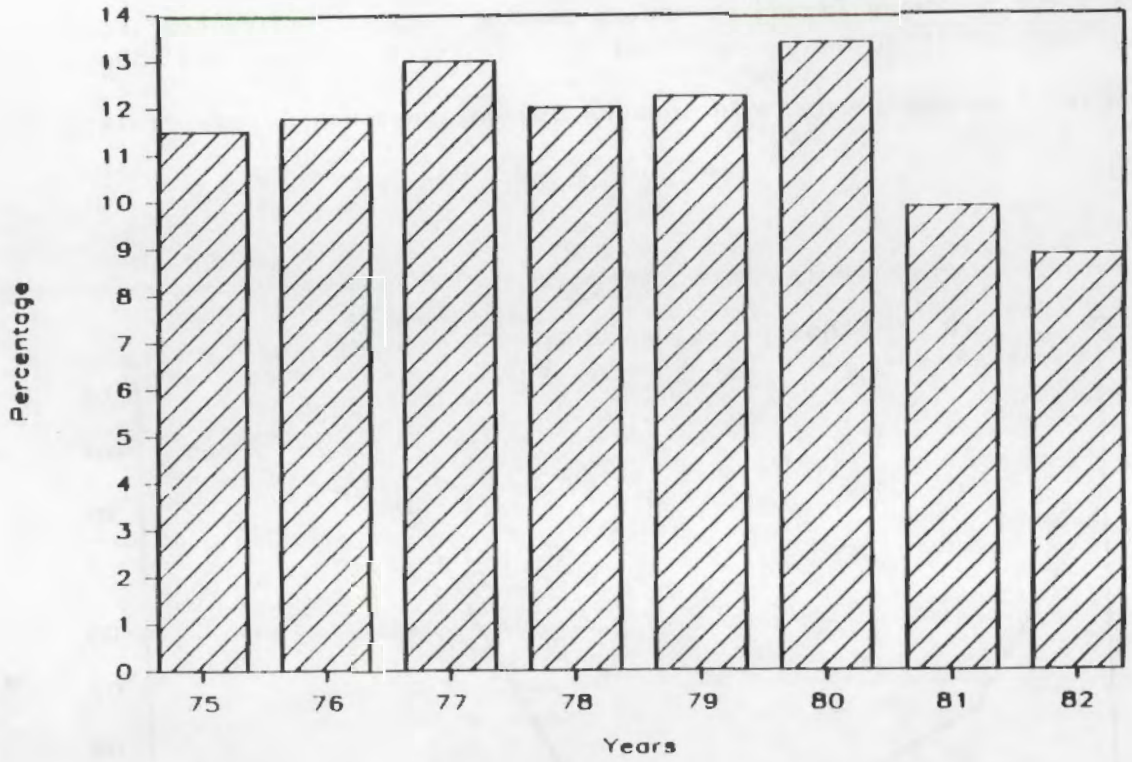

FIGURE 4.8(d). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, Other Manufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

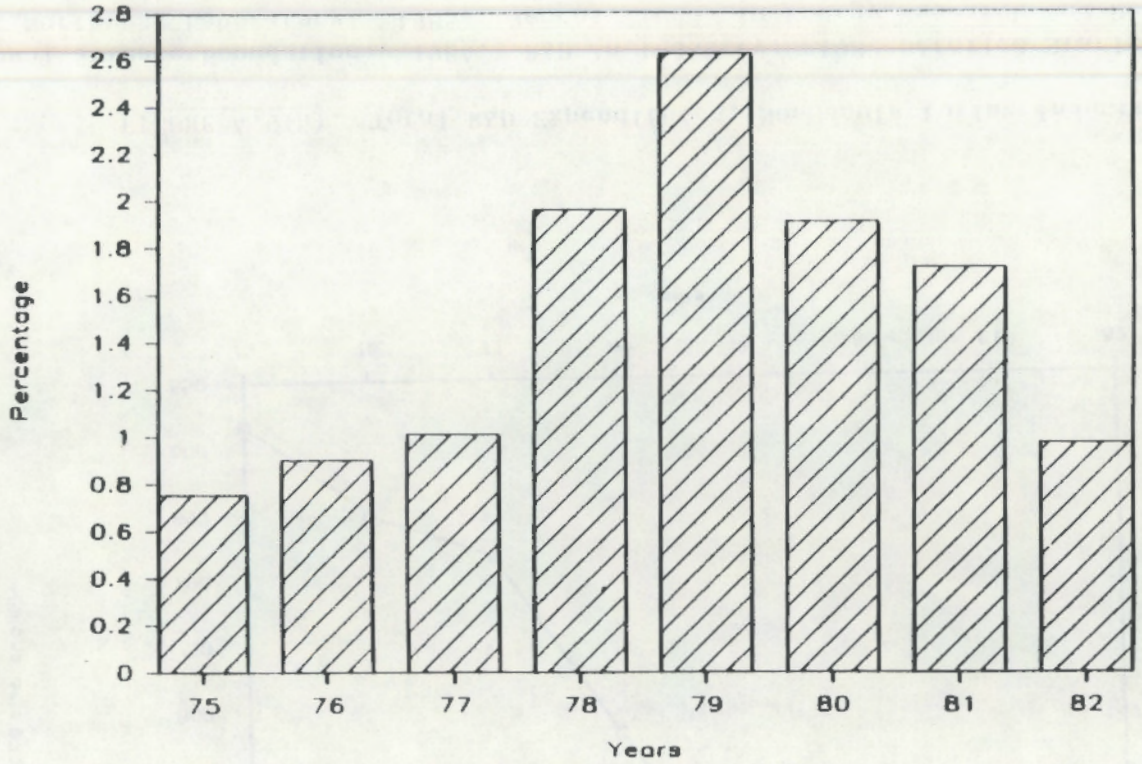

FIGURE 4.8(e). Energy Conservation R&D Expenditures as a Percentage of Total R&D Expenditures, Other Manufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

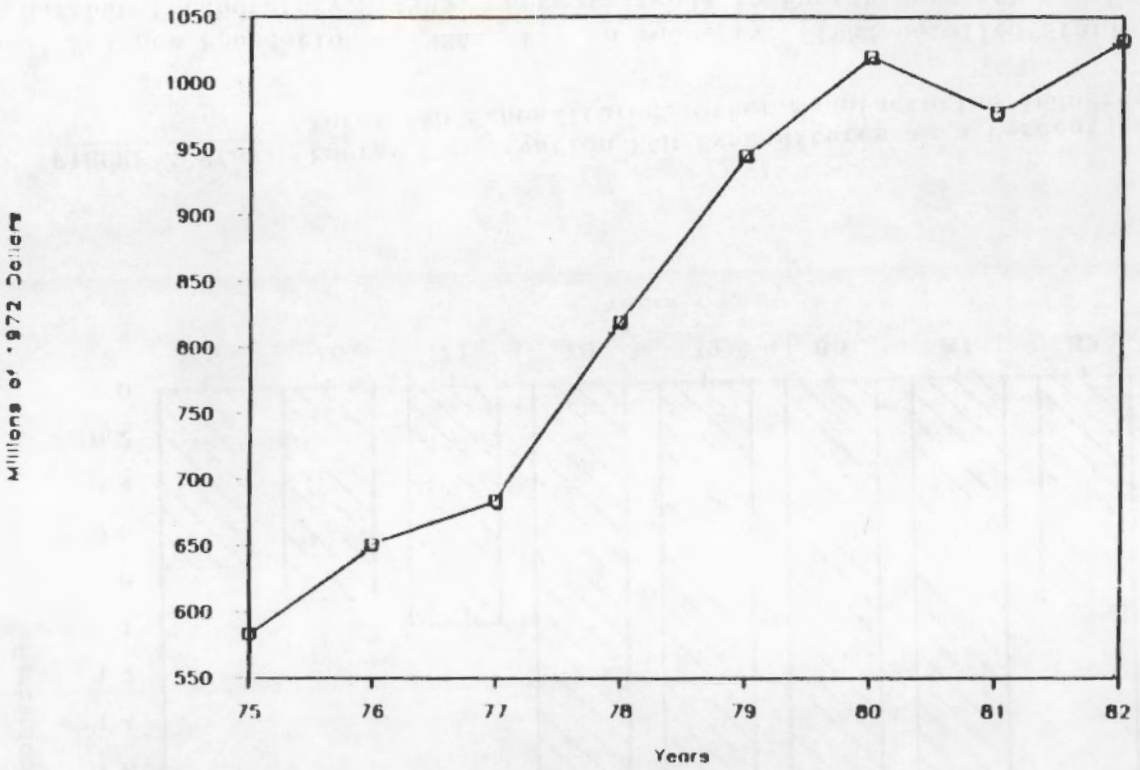

FIGURE 4.9(a). Total R&D Expenditures, NonManufacturing Industry

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

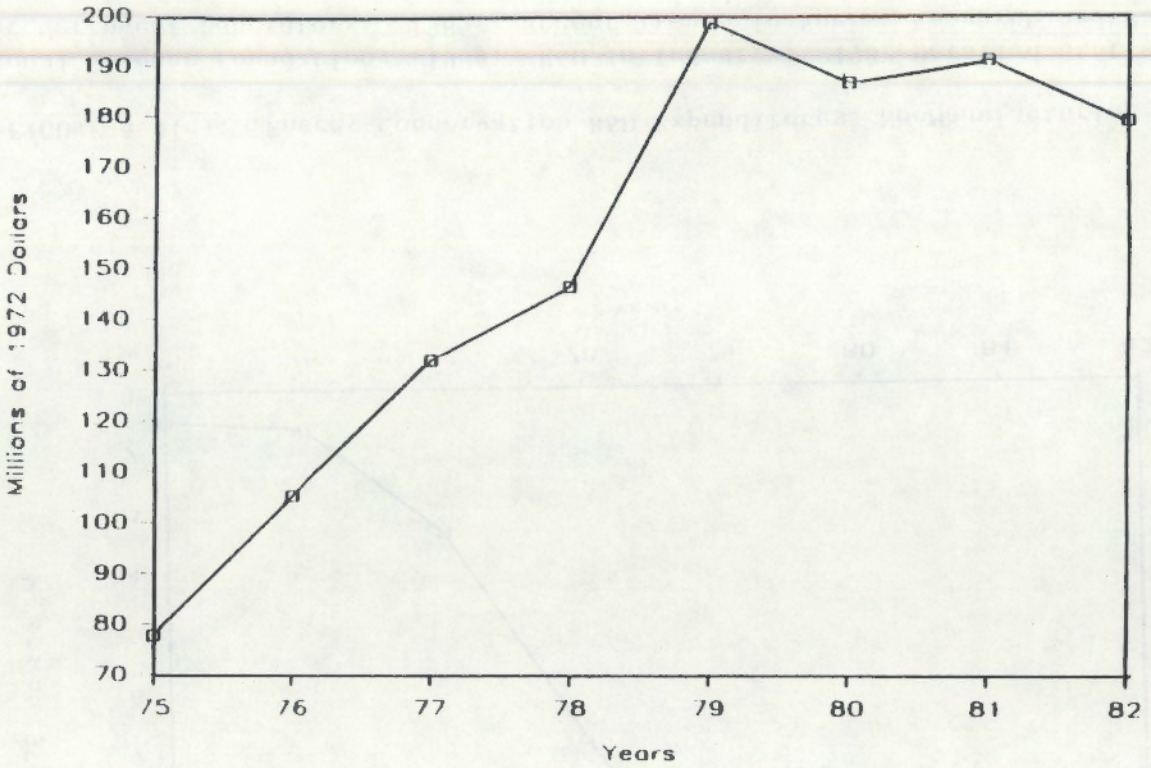

FIGURE 4.9(b). Energy R&D Expenditures, NonManufacturing Industry

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

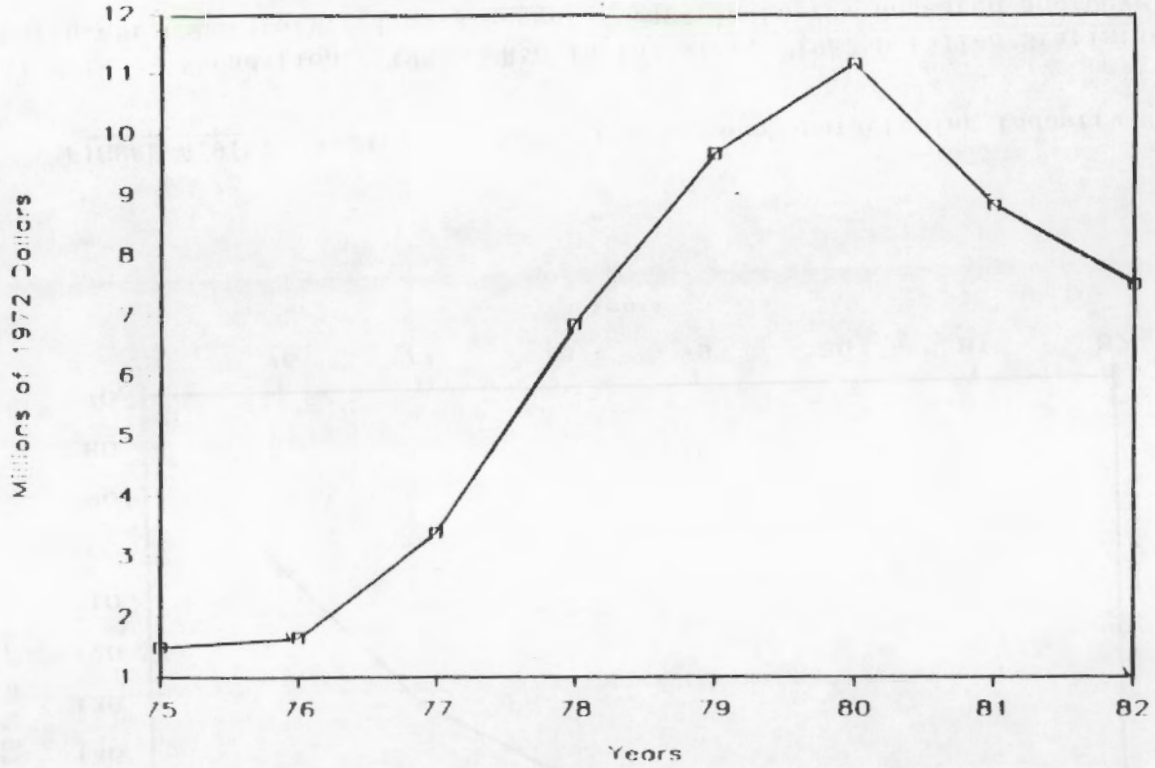

FIGURE 4.9(c). Energy Conservation R&D Expenditures, NonManufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

for the entire period, peaking in 1980, before decreasing in 1981 and 1982.

Figures 4.9 (d) and (e) show real energy and energy conservation R&D expenditures as a percentage of real total R&D expenditures for the industry. As shown by Figure 4.9 (d), energy as a percentage of total varied considerably during the 1975-1982 period, attaining its highest share (approximately 21 percent) in 1979. Energy conservation's share of total, as shown by Figure 4.9 (e), increased in the period between 1975 and 1980, peaking in 1980 at 1.1 percent, before decreasing to less than .8 percent in 1982.

4.10 ALL INDUSTRIES

Figures 4.10 (a), (b), and (c) show real R&D expenditure trends for all industries combined. Real total R&D expenditures increased at a near-constant rate of .056 between 1975 and 1982. Real energy R&D expenditures also increased at an annual average rate of .056 for the entire period, as shown by Figure 4.10 (b). Real energy expenditures increased substantially between 1975 and 1980 before declining in 1981 and 1982. As shown by Figure 4.10 (c), real energy conservation R&D expenditures increased at an average annual rate of .111 for the entire period, increasing dramatically in the 1975-1979 period, peaking in 1979, and declining in the period between 1979 and 1982.

Figures 4.10 (d) and (e) show real energy and energy conservation R&D expenditures as a percentage of real total R&D expenditures for all industries. Energy's share of total R&D increased between 1975 and 1979, from more than 7 percent to approximately 9.5 percent, before decreasing in 1982 to less than 8 percent. As shown by Figure 4.10 (e), energy conservation's share of total increased substantially during the 1976-1979 period, reaching its peak in 1979 at almost .9 percent of total, before decreasing by almost the same amounts in the 1980-1982 period.

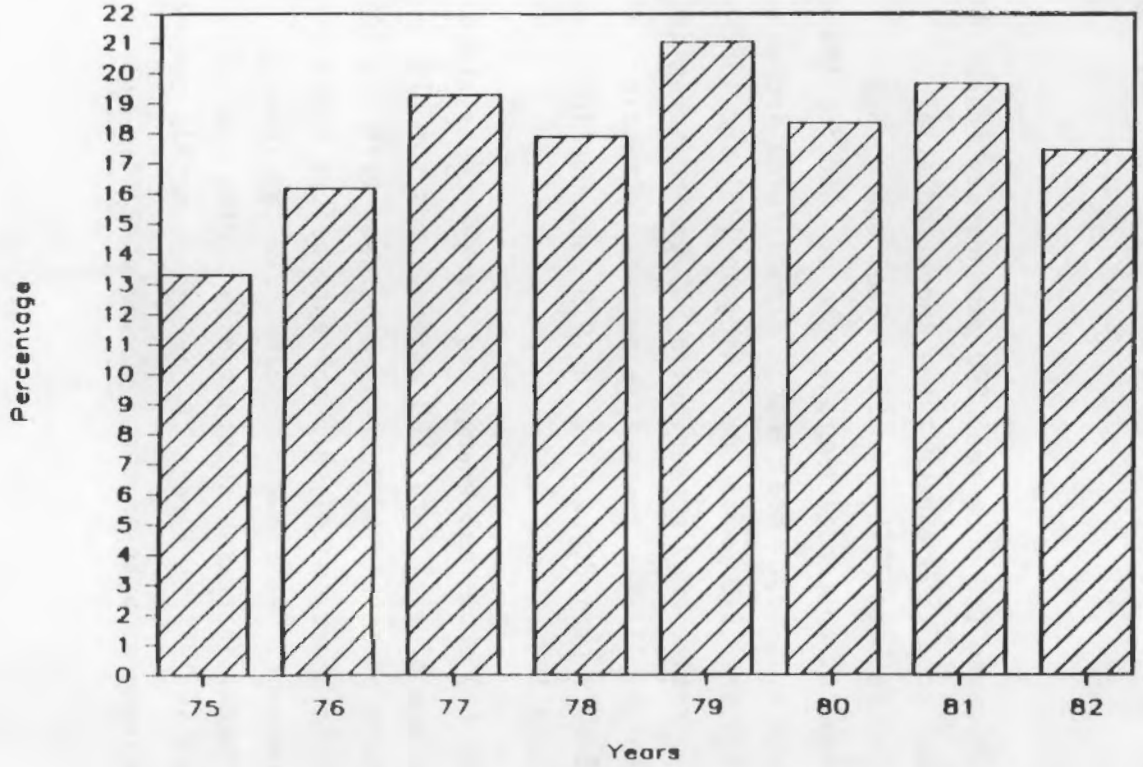

FIGURE 4.9(d). Energy R&D Expenditures as a Percentage of Total R&D Expenditures, NonManufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

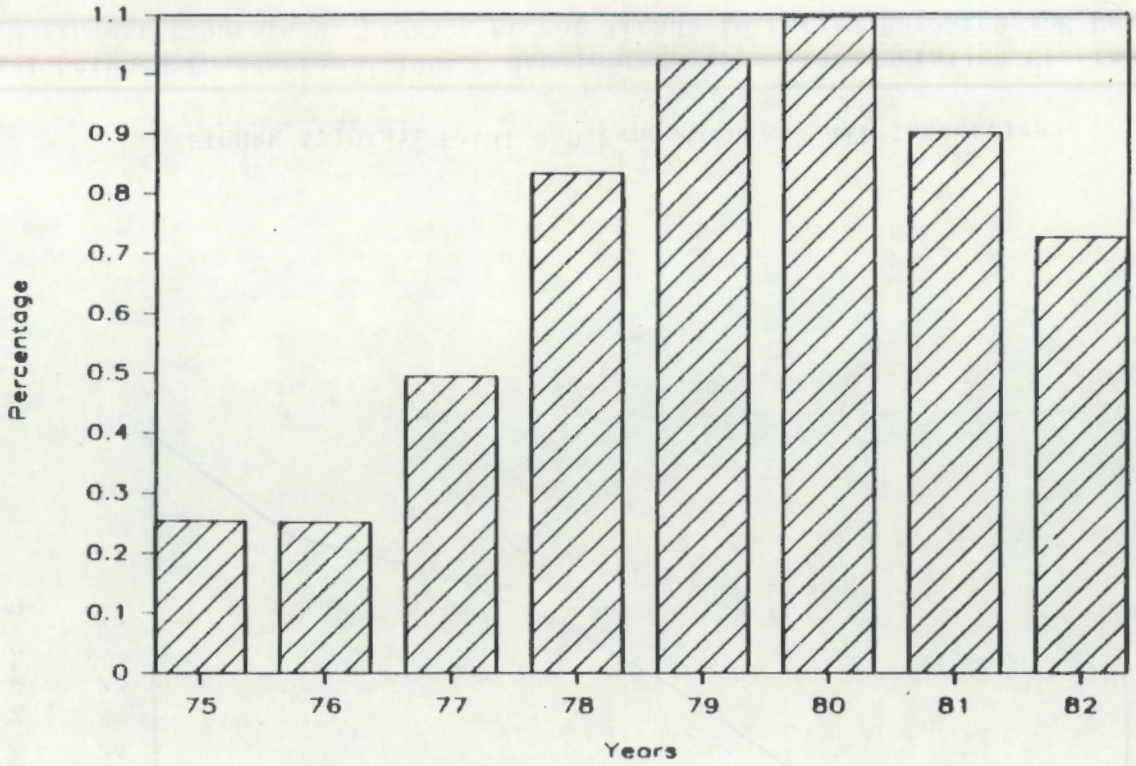

FIGURE 4.9(e). Energy Conservation R&D Expenditures as a Percentage of Total R&D Expenditures, NonManufacturing Industry.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

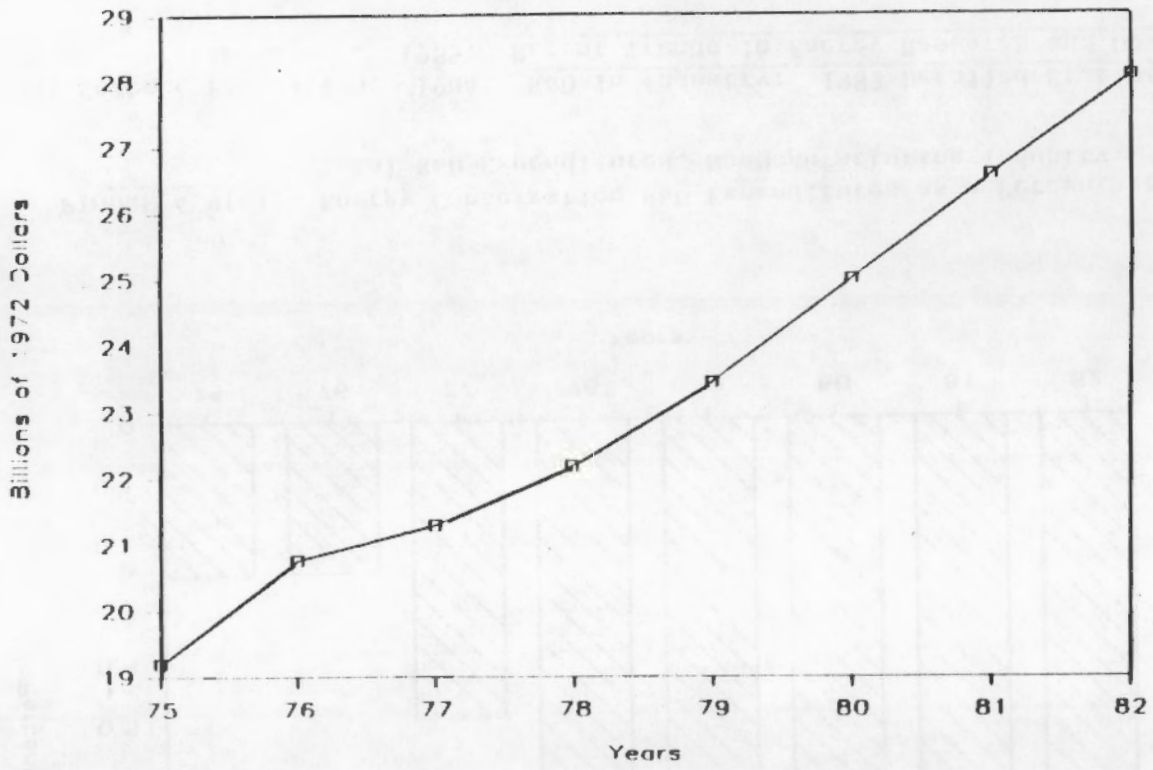

FIGURE 4.10(a). Total R&D Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

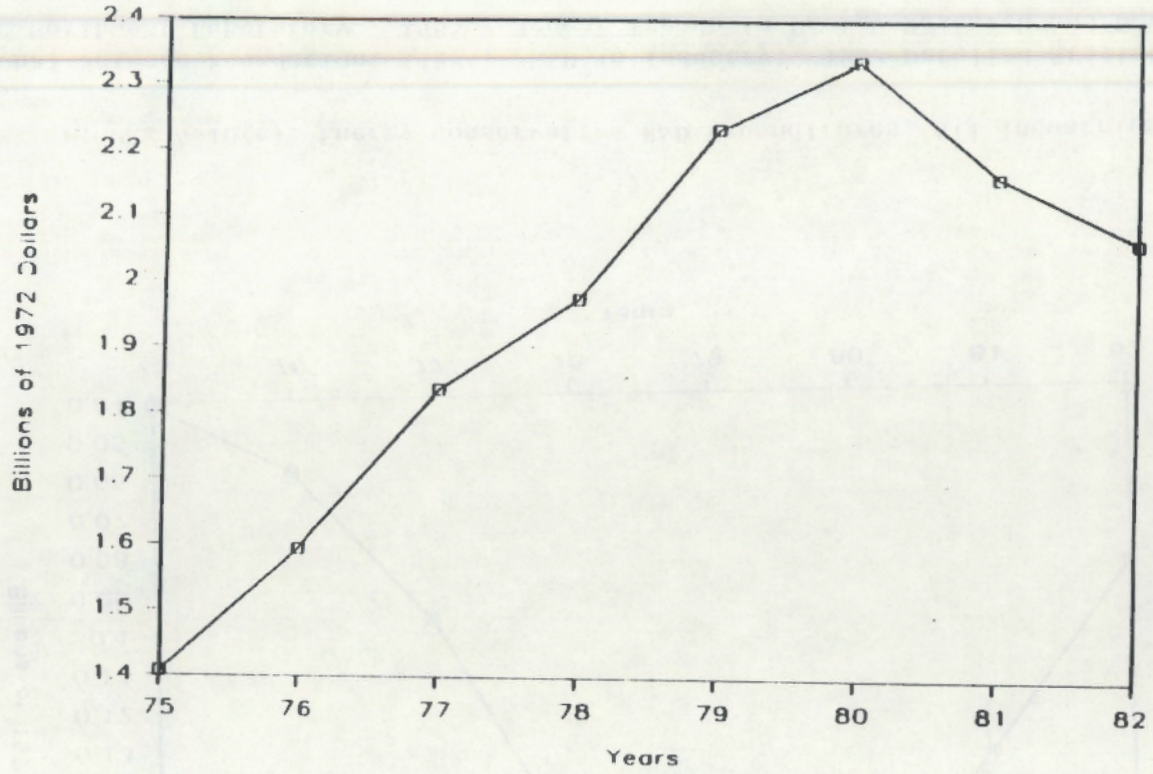

FIGURE 4.10(b). Energy R&D Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

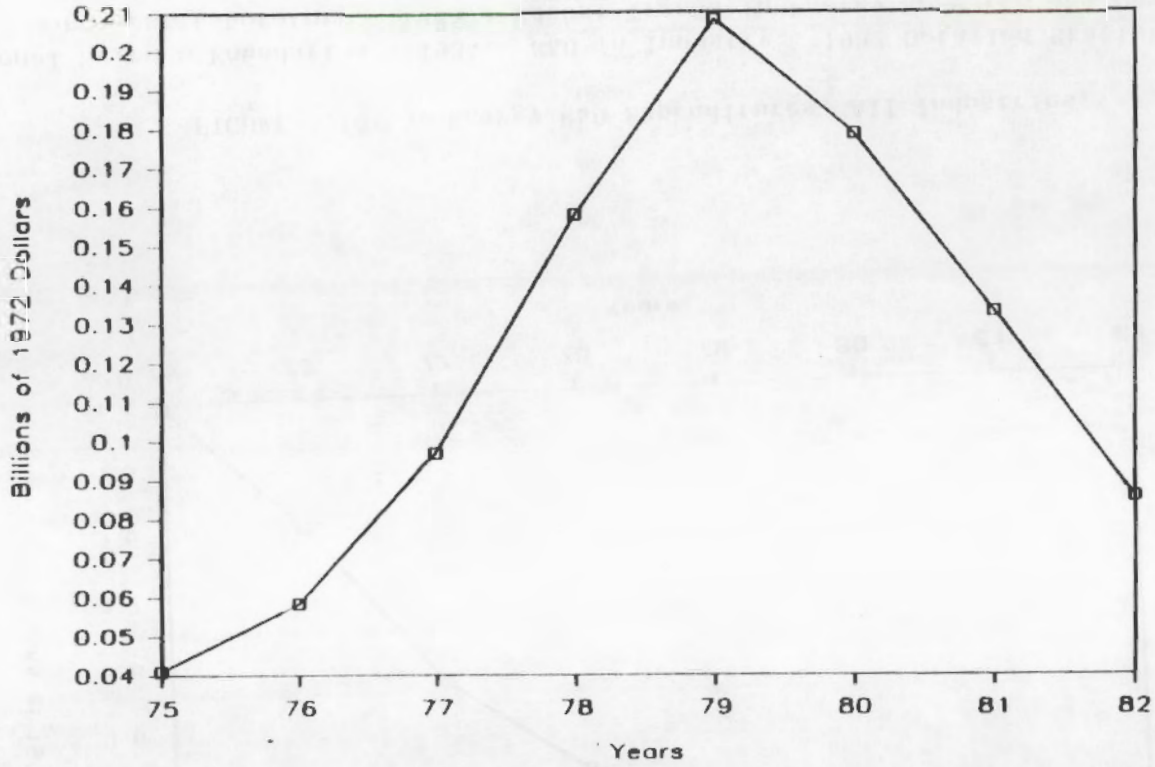

FIGURE 4.10(c). Energy Conservation R&D Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
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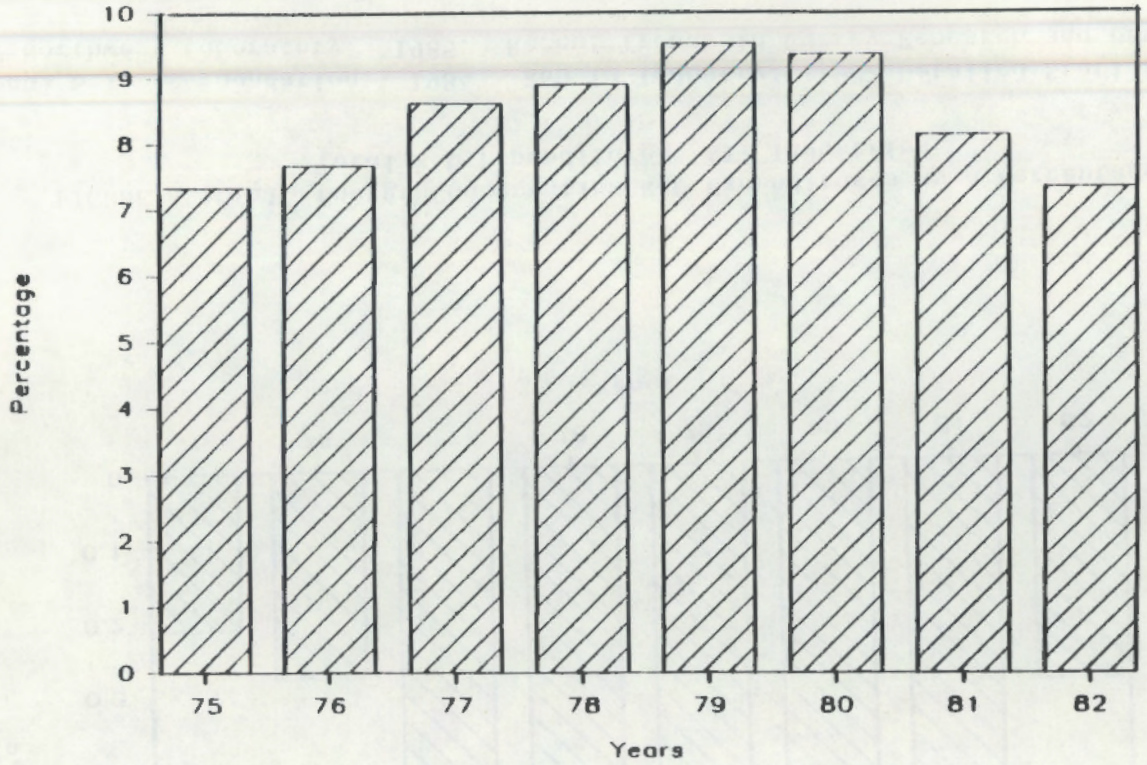

FIGURE 4.10(d). Energy R&D Expenditures as a Percentage of Total Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

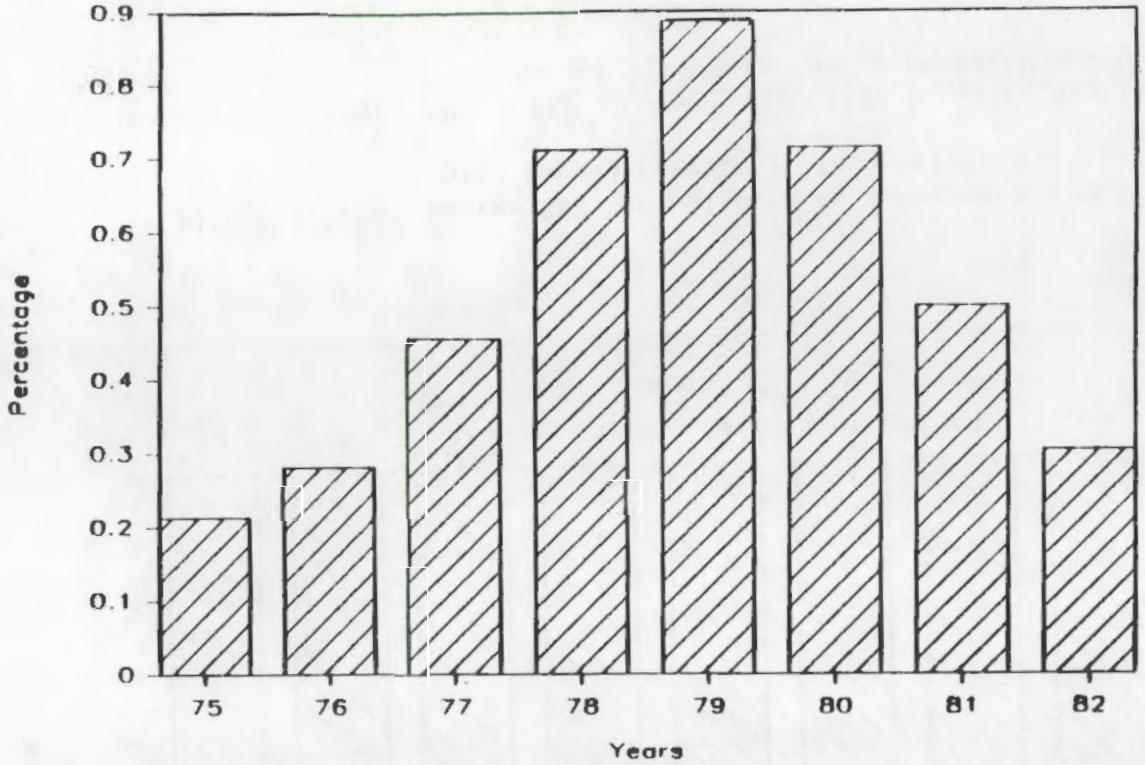

FIGURE 4.10(e). Energy Conservation R&D Expenditures as a Percentage of Total R&D Expenditures, All Industries.

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.
FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

APPENDIX

DATA FOR GRAPHICAL, NUMERICAL, AND ECONOMIC ANALYSIS

TABLE A.1. Research and Development Expenditures, by Industry, Type of R&D, and Year (Millions of Nominal Dollars)

YEARS	1975	1976	1977	1978	1979	1980	1981	1982
CHEMICALS								
TOTAL	2727	3017	3202	3580	4038	4636	5625	6588
ENERGY	102	121	148	157	220	257	312	346
ENERGY CONSERVATION	4	6	10	26	72	49	24	24
PETROLEUM[a]								
TOTAL	693	767	918	1060	1261	1552	1748	1934
ENERGY	405	440	536	648	776	845	1067	1183
PRIMARY METALS								
TOTAL	443	507	538	560	634	728	878	1005
ENERGY	27	33	51	49	72	78	80	101
ENERGY CONSERVATION	3	10	18	20	21	25	17	17
MACHINERY								
TOTAL	3196	3487	3880		4825	5901	6818	7879
ENERGY	23	40	61	80	83	108	127	194
ENERGY CONSERVATION	2	4	12	12	12	9	12	2
ELECTRICAL EQUIPMENT								
TOTAL	5105	5636	5886	6507	7824	9175	10329	11925
ENERGY	464	585	650	714	843	917	908	873
ENERGY CONSERVATION	8	8	32	40	49	53	35	30
AIRCRAFT AND MISSILES[a]								
TOTAL	5713	6339	7033	7536	8041	9198	11968	14044
ENERGY	134	110	165	283	372	446	412	352
PROFESSIONAL AND SCIENTIFIC INSTRUMENTS[a]								
TOTAL	1173	1131	1571	1998	2505	3029	3614	4047
ENERGY	14	10	17	27	28	45	53	76
OTHER MANUFACTURING								
TOTAL	4402	5067	5839	6551	7557	8471	8924	9369
ENERGY	507	597	760	787	925	1133	883	931
ENERGY CONSERVATION	33	46	59	129	199	162	154	92
NONMANUFACTURING								
TOTAL	735	846	957	1229	1539	1815	1906	2168
ENERGY	98	137	185	220	324	333	374	378
ENERGY CONSERVATION	2	2	5	10	16	20	17	16
ALL INDUSTRIES								
TOTAL	24187	26997	29825	33304	38226	44505	51810	58960
ENERGY	1774	2023	2573	2965	3643	4162	4216	4334
ENERGY CONSERVATION	52	76	136	237	339	318	260	180

[a] Energy Conservation Data Not Available

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.

FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

TABLE A.2. U.S. Gross National Product Implicit Price Deflator, by Year (1972=100)

Year	Deflator
1975	125.79
1976	132.34
1977	140.05
1978	150.42
1979	163.42
1980	178.64
1981	195.51
1982	207.23

SOURCE: Council of Economic Advisers. 1984. Economic Report of the President.

FROM: Pacific Northwest Laboratory. 1985. Recent Trends in Energy Research and Development Expenditures.

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