

Energy Consumption Series

Buildings and Energy in the 1980's

June 1995

Energy Information Administration
Office of Energy Markets and End Use
U.S. Department of Energy
Washington, DC 20585

This report was prepared by the Energy Information Administration, the independent statistical and analytical agency within the Department of Energy. The information contained herein should not be construed as advocating or reflecting any policy position of the Department of Energy or any other organization.

Contacts

This publication was prepared under the general direction of W. Calvin Kilgore, Director of the Office of Energy Markets and End Use (202/586-1617), and Lynda T. Carlson, Director of the Energy End Use and Integrated Statistics Division (EEUISD) (202/586-1112). Specific information regarding the contents or preparation of this publication can be obtained from Dwight K. French, Chief of the Transportation and Industrial Branch (202/586-1126). Questions regarding the Commercial Buildings Energy Consumption Survey (CBECS) may be referred to Martha M. Johnson, Survey Manager (202/586-1135). Questions regarding the Residential Energy Consumption Survey (CBECS) may be referred to Wendel Thompson, Survey Manager (202/586-1119). The FAX number for all EEUISD personnel is 202/586-0018.

Detailed technical questions on the topics in this publication may be referred to the following members of EEUISD:

| | | | |
|----------------------|--|----------------|----------------------|
| Alan Swenson | Principal Author | (202) 586-1129 | aswenson@eia.doe.gov |
| Eugene M. Burns | Technical Advisor | (202) 586-1125 | eburns@eia.doe.gov |
| Christy Hall | Appendices | (202) 586-1068 | chall@eia.doe.gov |
| Stephanie J. Battles | Appendix C Calculation of Energy Price Indices | (202) 586-7237 | sbattles@eia.doe.gov |

The following persons also made important contributions to this publication:

| | | | |
|----------------|-------------------|----------------|----------------------|
| Hattie Ramseur | Report Production | (202) 586-1124 | hramseur@eia.doe.gov |
| Linda Owens | Technical Monitor | (202) 586-5891 | lowens@eia.doe.gov |

Contents

| | <i>Page</i> |
|--|-------------|
| Section 1. Highlights | 1 |
| Introduction | 1 |
| Dominance of Single-Family Detached Homes | 3 |
| Age Distribution of Buildings | 5 |
| Major Energy Sources--Trends in Use and Consumption | 6 |
| Major Electricity and Natural Gas End Uses | 8 |
| Trends in Energy Intensity | 11 |
| Trends in Expenditures | 12 |
| Section 2. Characteristics of Buildings in the 1980's | 15 |
| Buildings and Floorspace by Type of Building | 16 |
| Buildings in Various Size Categories | 19 |
| Buildings and Floorspace by Census Region | 20 |
| Buildings and Floorspace by Year Constructed | 22 |
| Section 3. Energy Sources and Uses | 27 |
| Energy Sources Used for Major End Uses | 28 |
| Energy Sources Used for Space Heating | 30 |
| Section 4. Energy Consumption and Expenditures | 37 |
| Consumption and Energy Intensities for Major Energy Sources | 37 |
| Consumption and Energy Intensity by End Use | 39 |
| Energy Consumption by Source and End Use | 41 |
| Energy Expenditures | 42 |
| Energy Consumption and Characteristics of Residential and Commercial Buildings | 45 |
| Appendices | |
| A. Detailed Tables | 65 |
| B. How the Surveys Were Conducted | 67 |
| C. Data Quality | 71 |
| D. Census Regions and Divisions Maps | 81 |
| E. Related EIA Energy Consumption Publications | 83 |
| Glossary | 91 |

Tables

| | | |
|------|---|----|
| 2.1 | Number and Total Floorspace of Residential and Commercial Buildings | 23 |
| 2.2 | Number of Residential Buildings and Total Floorspace, 1980 and 1990 | 24 |
| 2.3 | Number of Commercial Buildings and Total Floorspace, 1979 and 1989 | 25 |
| 3.1a | Energy Sources Used for All End Uses in Residential Buildings, Number of Buildings and Total Floorspace | 32 |
| 3.1b | Energy Sources Used for Main Space Heating in Residential Buildings, Number of Buildings and Total Floorspace | 32 |

| | | |
|------|---|----|
| 3.2a | Energy Sources Used for All End Uses in Commercial Buildings, Number of Buildings and Total Floorspace | 33 |
| 3.2b | Energy Sources Used for Space Heating in Commercial Buildings, Number of Buildings and Total Floorspace | 33 |
| 3.3 | Major End Uses by Energy Source Used in Residential Buildings, Number of Buildings | 34 |
| 3.4 | Major End Uses by Energy Sources Used in Commercial Buildings, Number of Buildings | 34 |
| 3.5 | Energy Sources Used for Main Space Heating in Residential Buildings, 1980 and 1990, Number of Buildings | 35 |
| 3.6 | Energy Sources Used for Space Heating in Commercial Buildings, 1979 and 1989, Number of Buildings | 36 |
| 4.1 | Total Primary Consumption for All End Uses by Major Energy Source in Residential Buildings | 57 |
| 4.2 | Energy Intensities for All End Uses by Major Energy Source in Residential Buildings | 57 |
| 4.3 | Total Primary Consumption for All End Uses by Major Energy Source in Commercial Buildings | 58 |
| 4.4 | Energy Intensities for All End Uses by Major Energy Source in Commercial Buildings | 58 |
| 4.5 | Total Primary Consumption by End Use in Residential Buildings | 59 |
| 4.6 | Energy Intensities by End Use in Residential Buildings | 59 |
| 4.7 | Total Primary Consumption by Major Energy Sources and End Uses in Residential Buildings | 60 |
| 4.8 | Total Primary Consumption by Major Energy Sources and End Uses in Commercial Buildings | 60 |
| 4.9a | Total Expenditures for All End Uses by Major Energy Source in Residential Buildings | 61 |
| 4.9b | Total Expenditures for All End Uses by Major Energy Source in Commercial Buildings | 61 |
| 4.10 | Total Expenditures by End Use in Residential Buildings | 62 |
| 4.11 | Total Primary Consumption and Energy Intensities in Residential Buildings, 1980 and 1990 | 63 |
| 4.12 | Total Primary Consumption and Energy Intensities in Commercial Buildings, 1979 and 1989 | 64 |
| B1 | RECS Survey Sample and Design, 1980 to 1990 | 67 |
| B2 | CBECS Survey Sample and Design, 1979 to 1990 | 68 |
| C1 | Energy Price indices, 1979 to 1991 | 77 |
| C2 | Residential Energy Price Indices for Specific Energy Sources, 1979 to 1990 | 78 |
| C3 | Commercial Energy Price Indices for Specific Energy Sources, 1979 to 1991 | 78 |
| C4 | Number of Commercial Buildings by Year of Construction and Survey Year | 79 |

Figures

| | | |
|------|---|----|
| 1.1 | Domestic Energy Production and Primary Domestic Energy Consumption, 1949-1993 | 2 |
| 1.2 | Primary Energy Consumption and Primary Residential and Commercial Consumption, 1949-1993 | 2 |
| 1.3 | Number of Residential and Commercial Buildings by Type of Building, 1990 RECS and 1989 CBECS | 3 |
| 1.4 | Total Residential and Commercial Floorspace by Type of Building, 1990 RECS and 1989 CBECS | 3 |
| 1.5 | Total Residential and Commercial Primary Consumption by Type of Building, 1990 RECS and 1989 CBECS | 4 |
| 1.6 | Total Residential and Commercial Energy Expenditures (1987 Dollars) by Type of Building, 1990 RECS and 1989 CBECS | 4 |
| 1.7 | Distribution of Buildings and Floorspace by Year Constructed | 5 |
| 1.8 | Use of Major Energy Sources for Any Use in the 1980's | 6 |
| 1.9 | Primary Energy Consumption by Major Energy Sources | 7 |
| 1.10 | Percent of Buildings Using Major Energy Sources for Major Energy Uses in the 1980's | 8 |
| 1.11 | Major Energy Source Consumption by End Use | 9 |
| 1.12 | Percent of Buildings Using Major Energy Sources for Space Heating by Year Constructed | 10 |
| 1.13 | Energy Intensities by Energy Source | 11 |
| 1.14 | Expenditures (1987 Dollars) for Energy by Energy Source | 12 |
| 1.15 | Expenditure Intensities by Energy Source | 13 |

| | | |
|------|---|----|
| 1.16 | Expenditures (1987 Dollars) for End Uses in Residential Buildings in the 1980's | 13 |
| 2.1 | Number and Size of Residential and Commercial Buildings in the 1980's | 15 |
| 2.2 | United States Population in the 1980's | 16 |
| 2.3 | Distribution of Residential Buildings and Floorspace by Type | 17 |
| 2.4 | Distribution of Commercial Buildings and Floorspace by Type | 17 |
| 2.5 | Average Size of Residential Buildings by Type | 18 |
| 2.6 | Average Size of Commercial Buildings by Type | 18 |
| 2.7 | Number of Residential Buildings by Size | 19 |
| 2.8 | Number of Commercial Buildings by Size | 20 |
| 2.9 | Distribution of Residential Buildings, Floorspace, and U.S. Population by Census Region | 21 |
| 2.10 | Distribution of Commercial Buildings, Floorspace, and U.S. Population by Census Region | 21 |
| 2.11 | Distribution of Buildings and Floorspace by Year Constructed | 22 |
| 3.1 | Percent of Buildings Using Major Energy Sources Used for Any Purposes in the 1980's | 27 |
| 3.2 | Percent of Floorspace Using Major Energy Sources for Any Purpose in the 1980's | 28 |
| 3.3 | Use of Electricity for Space Heating, Air Conditioning, and Water Heating in Residential and Commercial Buildings in the 1980's | 29 |
| 3.4 | Use of Natural Gas and Fuel Oil for Space Heating and Water Heating in Residential and Commercial Buildings in the 1980's | 29 |
| 3.5 | Energy Sources Used for Space Heating in Buildings in the 1980's | 30 |
| 3.6 | Energy Sources Used for Space Heating in Buildings by Age of Building | 31 |
| 3.7 | Energy Sources Used for Space Heating in Buildings by Census Region | 31 |
| 4.1 | Residential and Commercial Buildings Energy Consumption and Energy Intensity in the 1980's | 37 |
| 4.2 | Residential Buildings Energy Consumption and Energy Intensity by Source, 1980 and 1990 | 38 |
| 4.3 | Commercial Buildings Energy Consumption and Energy Intensity by Source, 1979 and 1989 | 39 |
| 4.4 | Residential Buildings Energy Consumption and Energy Intensity by End Use, 1980 and 1990 | 40 |
| 4.5 | Commercial Buildings Energy Consumption and Energy Intensity by End Use, 1989 | 40 |
| 4.6 | Energy Consumption by Energy Source and End Use in Residential Buildings, 1980 and 1990 | 41 |
| 4.7 | Energy Consumption by Energy Source and End Use in Commercial Buildings, 1989 | 42 |
| 4.8 | Total Expenditures (1987 Dollars) for Energy in Residential and Commercial Building in the 1980's | 43 |
| 4.9 | Expenditures (1987 Dollars) for End Uses in Residential Buildings in the 1980's | 43 |
| 4.10 | Residential and Commercial Buildings Expenditures (1987 Dollars) by Energy Source | 44 |
| 4.11 | Residential and Commercial Buildings Expenditure Intensities (1987 Dollars) by Energy Source | 44 |
| 4.12 | Total Primary Energy Consumption by Building Type, 1990 RECS and 1989 CBECS | 45 |
| 4.13 | Primary Energy Consumption and Energy Intensity by Type of Residential Building, 1980 and 1990 | 47 |
| 4.14 | Primary Energy Consumption and Energy Intensity by Type of Commercial Building, 1979 and 1989 | 47 |
| 4.15 | Natural Gas and Electricity Energy Intensity by Type of Residential Building, 1980 and 1990 | 48 |
| 4.16 | Natural Gas and Electricity Energy Intensity by Type of Commercial Building, 1979 and 1989 | 48 |
| 4.17 | Primary Energy Consumption and Energy Intensity in Residential Buildings by Size of Building, 1980 and 1990 | 49 |
| 4.18 | Primary Energy Consumption and Energy Intensity in Commercial Buildings by Size of Building, 1979 and 1989 | 50 |
| 4.19 | Natural Gas and Electricity Energy Intensity in Residential Buildings by Size of Building, 1980 and 1990 | 50 |
| 4.20 | Natural Gas and Electricity Energy Intensity in Commercial Buildings by Size of Building, 1979 and 1989 | 51 |
| 4.21 | Primary Energy Consumption and Energy Intensity in Residential Buildings by Census Region, 1980 and 1990 | 52 |
| 4.22 | Primary Energy Consumption and Energy Intensity in Commercial Buildings by Census Region, 1979 and 1989 | 52 |
| 4.23 | Natural Gas and Electricity Energy Intensity in Residential Buildings by Census Region, 1980 and 1990 | 53 |

| | | |
|------|--|----|
| 4.24 | Natural Gas and Electricity Energy Intensity in Commercial Buildings by Census Region, 1979 and 1989 | 53 |
| 4.25 | Primary Energy Consumption and Energy Intensity in Residential Buildings by Year Constructed, 1980 and 1990 | 54 |
| 4.26 | Primary Energy Consumption and Energy Intensity in Commercial Buildings by Year Constructed, 1979 and 1989 | 55 |
| 4.27 | Natural Gas and Electricity Energy Intensity in Residential Buildings by Year Constructed, 1980 and 1990 | 55 |
| 4.28 | Natural Gas and Electricity Energy Intensity in Commercial Buildings by Year Constructed, 1979 and 1989 | 56 |
| C1 | Use of RSE Row and Column Factors | 73 |

1. Highlights

Introduction

The Energy Information Administration (EIA) collects data on energy consumption, expenditures, and other energy-related topics in the major energy-consuming sectors of the U.S. economy. The residential and commercial sectors are two major sectors that many energy analysts like to consider together, as energy use is primarily related to the building shell and the stock of energy-consuming goods within the shell in these sectors. EIA conducts separate surveys for the two sectors, the Residential Energy Consumption Survey (RECS) and the Commercial Buildings Energy Consumption Survey (CBECS).¹ Prior to the first CBECS, there was a very poor understanding of the complexities of energy use in commercial buildings, or the amount of energy consumed in the commercial sector. This report summarizes and synthesizes energy data that were collected by these two surveys during the 1980's, when major changes in energy policy were implemented following the energy crisis decade of the 1970's.

The six RECS and four CBECS data bases from the ten consumption surveys over the 1979 to 1990 time frame contain a wealth of energy end use information on residential and commercial buildings. This is the first report to present a unified vision of energy use in residential and commercial buildings. This report presents energy data that are consistent between the two sectors and across the decade of the 1980's. This report differs from previous consumption reports because all consumption statistics are reported in terms of primary electricity consumption and site energy for all other energy sources.²

The availability of inexpensive, secure energy became less certain by the early 1970's. Although energy demand (total energy consumption, Figure 1.1) had continued its long rise into the 1970's, the production of domestic oil (a primary source of energy) peaked in 1970 and forced greater reliance on energy imports. The Arab oil embargo in 1973-1974 served as the catalyst for the energy crisis; oil supplies were constrained and energy prices rose sharply. In both the 1970's and 1980's, the price of oil had a large impact on the economy, the price of other fuels, and on total energy consumption. Both the sharp price increase in 1974 and again in 1979 (following the 1978 Iranian revolution) contributed to economic downturns and fueled much of the high inflation of the period.

During the 1970's, the promise of higher energy prices for the foreseeable future and the uncertainty of adequate supplies led to public discussion and development of a comprehensive energy policy that could produce long-term solutions to the energy crisis. Four generally agreed upon goals of the policy were: adequate energy supplies, reduced dependence on energy imports, protection against the disruption of foreign supplies, and increased conservation and efficiency in end uses.

Many energy programs were put into place during the 1970's and 1980's to lessen the dependence upon foreign oil supplies and to improve how all forms of energy are used. A significant percent of total energy consumption occurred in the residential and commercial sectors (Figure 1.2). This report concentrates on the physical makeup of the residential and commercial buildings sectors and their use of energy, and examines changes that occurred during the 1980's.

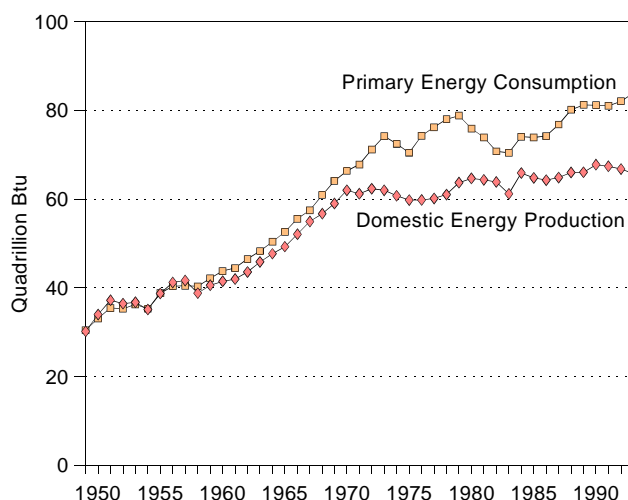
The remainder of this chapter presents a summary of major findings. The following three chapters focus on different aspects of the overarching theme of buildings and energy in the 1980's. Chapter 2 discusses major characteristics

¹Residential Energy Consumption Surveys were conducted in 1980, 1981, 1982, 1984, 1987, and 1990. Commercial Buildings Energy Consumption Surveys were conducted in 1979, 1983, 1986, and 1989. Prior to the 1989 CBECS, that survey was called the Nonresidential Buildings Energy Consumption Survey. The RECS and CBECS are presently conducted triennially and each supports two major publications, one covering buildings characteristics, and one covering energy consumption and expenditures.

²Primary electricity consumption takes into account the energy inputs used to produce and transmit electricity. Site energy consumption is the amount of energy delivered to a site. See Appendix C, "Data Quality."

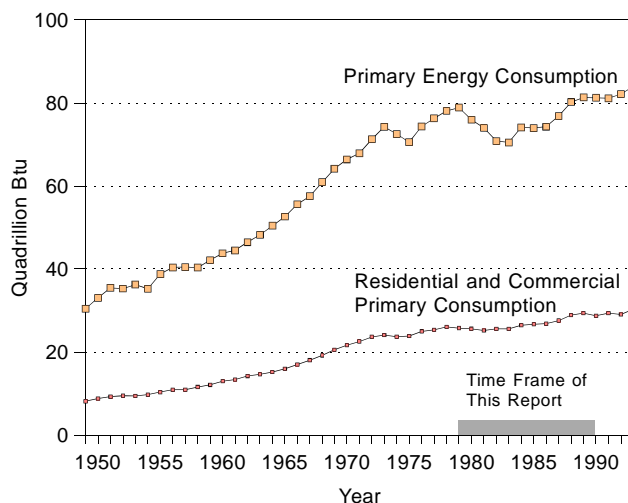
of residential and commercial buildings. Chapter 3 considers the major energy sources and end uses in terms of number of buildings and floorspace. Chapter 4 focuses on energy consumption and expenditures. Chapters 2, 3, and 4 contain tables at the end of each chapter that summarize data from detailed tables that are available separately on diskette or via EIA's Electronic Publishing System (EPUB). Following the body of the report, appendices and a glossary provide additional information on the methodologies used in this report and on the residential and commercial building consumption surveys on which this report is based.

Figure 1.1. Domestic Energy Production and Primary Domestic Energy Consumption, 1949-1993



Source: Energy Information Administration, *Annual Energy Review 1993*, DOE/EIA-0384(93).

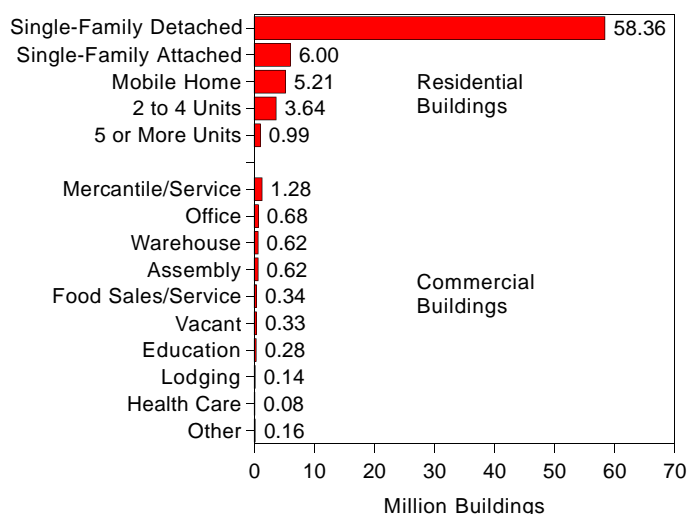
Figure 1.2. Primary Energy Consumption and Primary Residential and Commercial Consumption, 1949-1993



Source: Energy Information Administration, *Annual Energy Review 1993*, DOE/EIA-0384(93).

Dominance of Single-Family Detached Homes

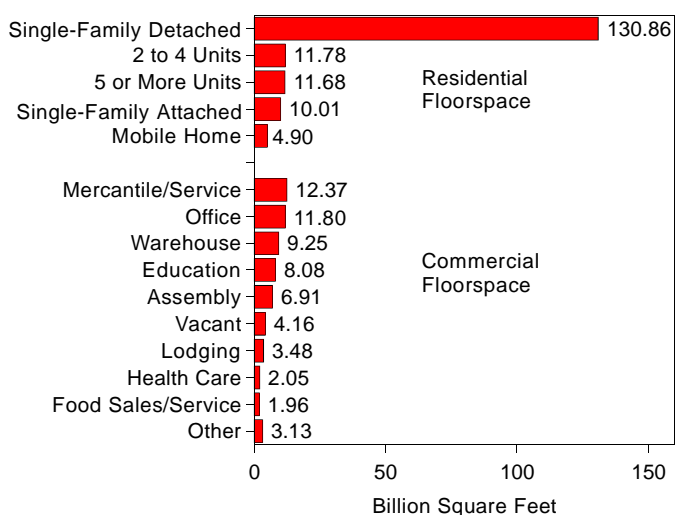
Figure 1.3. Number of Residential and Commercial Buildings by Type of Building, 1990 RECS and 1989 CBECS



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

- Single-family detached homes exceeded all other building types combined in both number of buildings and total floorspace (Figures 1.3 and 1.4).
- Single-family detached homes accounted for nearly three-fourths of the buildings in the two sectors (Figure 1.3).
- Commercial buildings constituted only six percent of buildings in both sectors.
- All other residential building types combined represented one-fifth of the total.

Figure 1.4. Total Residential and Commercial Floorspace by Type of Building, 1990 RECS and 1989 CBECS

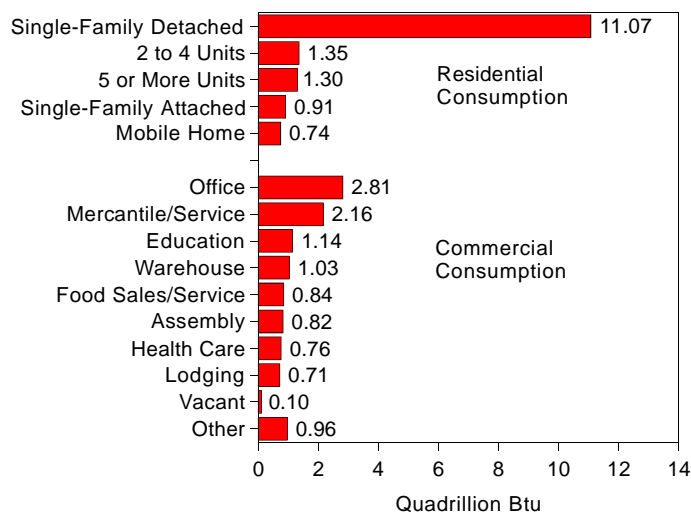


Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

- Single-family detached homes accounted for more than half of residential and commercial floorspace (Figure 1.4).
- Commercial buildings represented slightly more than one-fourth of residential and commercial floorspace, a larger share than the number of buildings because of their larger average size.
- All other residential buildings constituted less than one-fifth of residential and commercial floorspace.

Figure 1.5. Total Residential and Commercial Primary Consumption by Type of Building, 1990 RECS and 1989 CBECS

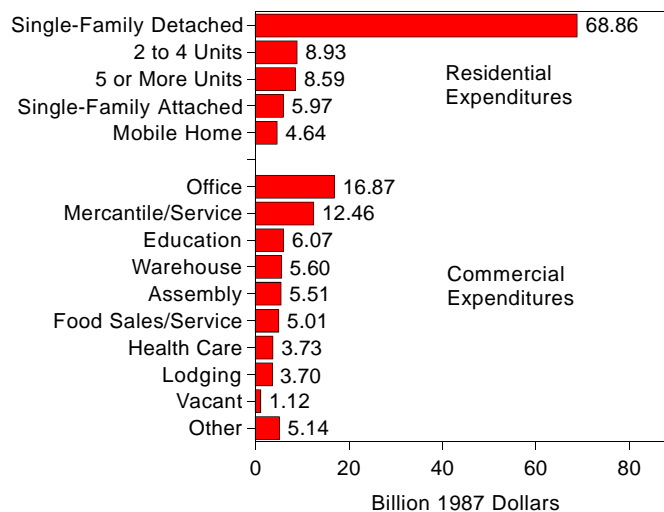
- Consumption and expenditures for energy in single-family detached homes exceeded those for all other building types (Figures 1.5 and 1.6).
- Consumption in single-family detached homes was 41 percent of the total, slightly less than the total for all commercial buildings (Figure 1.5).



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 1.6. Total Residential and Commercial Energy Expenditures (1987 Dollars) by Type of Building, 1990 RECS and 1989 CBECS*

- Expenditures (in 1987 dollars) for single-family detached homes were about 44 percent of the total for both sectors, and about 5 percent more than the total expenditures for all commercial buildings (Figure 1.6).



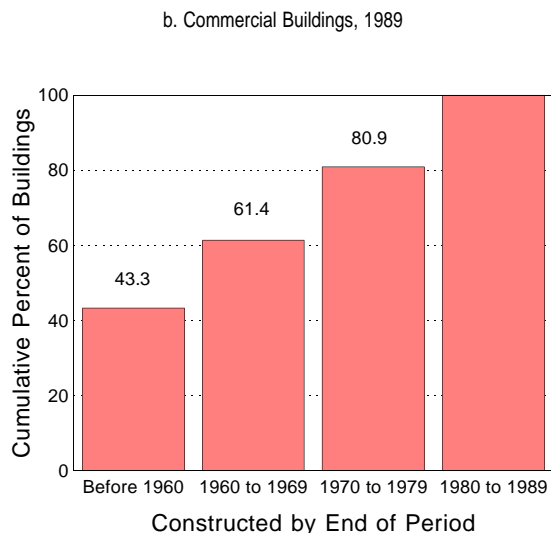
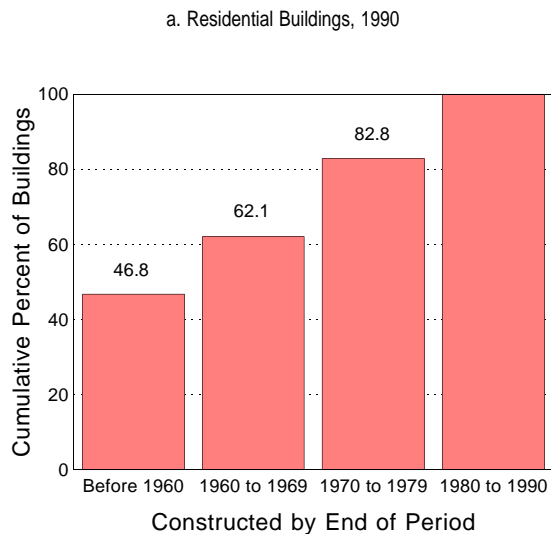
* See Appendix C, "Data Quality", for adjustment to 1987 dollars.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Age Distribution of Buildings

The relatively slow turnover in the building stock is revealed in both the RECS and CBECS data. Residential and commercial buildings constructed during the 1980's represent a small fraction of the entire stock--only 17 percent of residential buildings and 19 percent of commercial buildings (Figures 1.7a and b). Because the bulk of the present building stock was constructed prior to 1980, energy efficient building practices employed in new construction in the 1980's will have greater impact in the future as the older, less efficient stock is retired, and new construction with efficiencies equal or superior to those of the 1980's construction takes its place.

Figure 1.7. Distribution of Buildings and Floorspace by Year Constructed



- At the end of the 1980's, buildings more than 30 years old (constructed before 1960) constituted a substantial fraction of the building population (Figures 1.7a and b).
- Greater than 46 percent of residential buildings and more than 43 percent of commercial buildings were constructed prior to 1960.
- The median age of both residential and commercial buildings at the end of the decade was just under 30 years. If this median age holds, 1980's and newer construction will not represent a majority of buildings until approximately 2010. If the median age increases, this date would be extended even further.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Major Energy Sources--Trends in Use and Consumption

Electricity and natural gas have been and continue to be the energy sources of choice (as measured by the percent of buildings that use them) in both residential and commercial buildings.³ The use of fuel oil, the third choice, declined during the 1980's.

Electricity

- Use of electricity was nearly universal in residential buildings, and was only slightly less in commercial buildings (those that did not use it in the 1980's were primarily warehouses or vacant buildings) (Figures 1.8a and b).
- Electricity consumption exceeded natural gas consumption and consumption by all other energy sources in both sectors (Figures 1.9a and b).

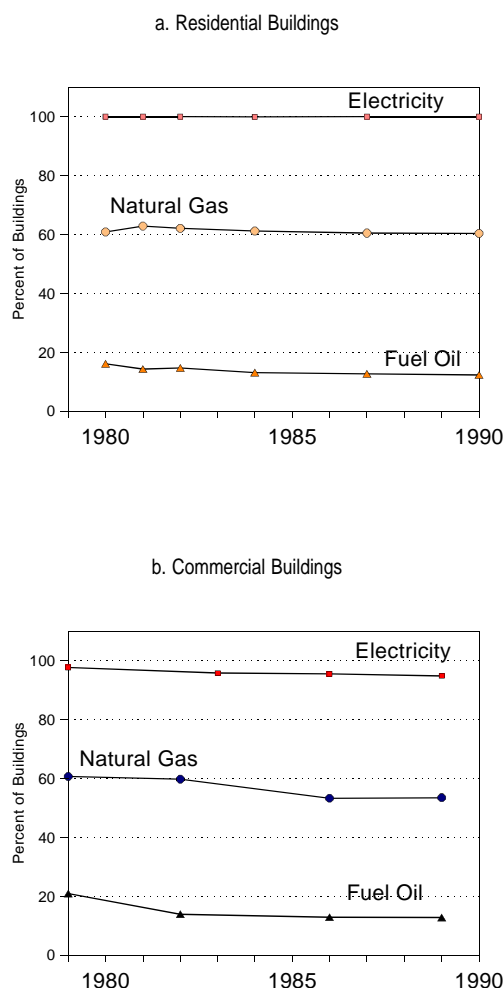
Natural Gas

- Natural gas was used in about 60 percent of buildings. The slight declines over time shown in Figures 1.8a and 1.8b are not statistically significant.
- Natural gas consumption was second to electricity consumption in both sectors. At the beginning of the decade, natural gas consumption was two-thirds that of electricity in residential buildings and 38 percent of that in commercial buildings. By the end of the decade, natural gas use was 53 percent of electricity use in residential buildings and one-fourth that of electricity in commercial buildings (Figures 1.9a and b).

Fuel Oil

- During the 1980's, the proportion of buildings that used fuel oil declined as did the total consumption of fuel oil in both residential and commercial buildings (Figures 1.8 a and b, 1.9a and b). Fuel oil use was regional, primarily limited to the Northeast and part of the South Census regions.

Figure 1.8. Use of Major Energy Sources for Any Use in the 1980's*



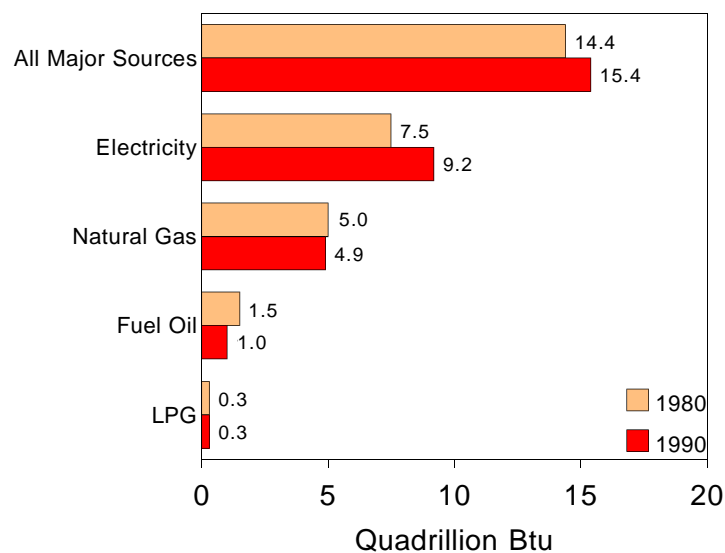
*In commercial buildings, fuel oil use includes kerosene.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

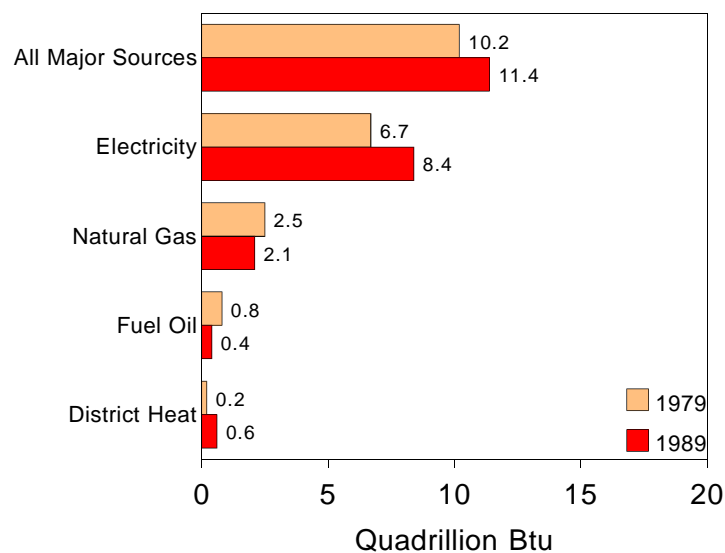
³Electricity energy consumption is expressed as primary consumption. Energy consumption is not adjusted for the effect of weather.

Figure 1.9. Primary Energy Consumption by Major Energy Sources*

a. Residential Buildings, 1980 and 1990



b. Commercial Buildings, 1979 and 1989



* All major energy sources and electricity consumption refer to primary electricity consumption. Fuel oil consumption includes kerosene. In residential buildings kerosene was less than 10 percent of total fuel oil consumed. It is not reported separately in commercial buildings.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Major Electricity and Natural Gas End Uses

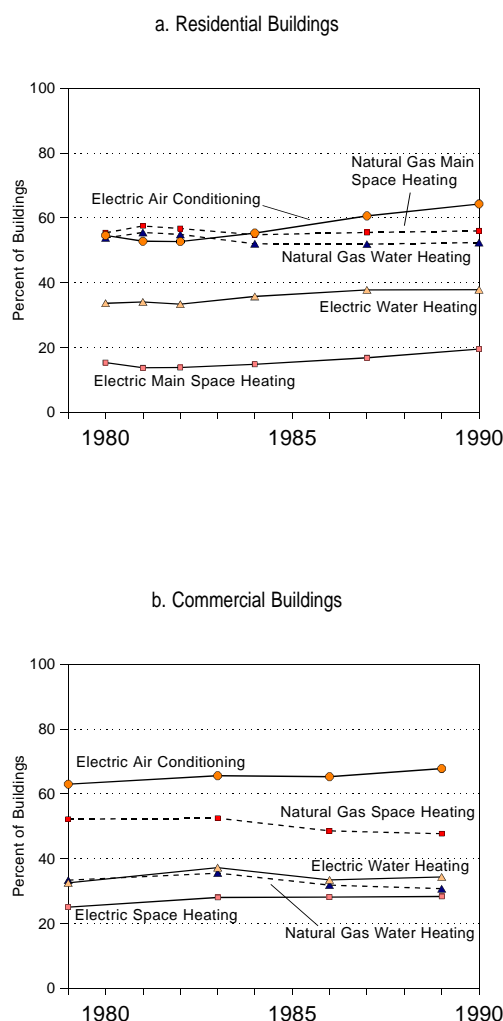
Electricity

- Excluding appliances and lighting, which used electricity almost universally, electricity use was most common for air conditioning (or cooling), followed by water heating and space heating in both residential and commercial buildings (Figures 1.10a and b).
- During the 1980's, the proportions of residential buildings that used electricity for main space heating and air conditioning showed a statistically significant increase. The slight increase shown in Figure 1.10b is not statistically significant.
- Lighting was the major consumer of electricity in commercial buildings, while appliances (which included lighting) was the major consumer in residential buildings. Both of these end uses exceeded any other end use by more than a factor of two (Figures 1.11a and b).

Natural Gas

- Nearly identical percentages of residential buildings used natural gas for main space heating and water heating, whereas in commercial buildings, use for space heating was greater than use for water heating by about 20 percentage points throughout the decade (Figures 1.10a and b). These showed no significant changes during the 1980's.
- In residential and commercial buildings, space heating and water heating were the two main uses of natural gas, with space heating accounting for about three times as much consumption as water heating (Figure 1.11a and b). Other natural gas end uses include range tops or burners, ovens, and clothes dryers.

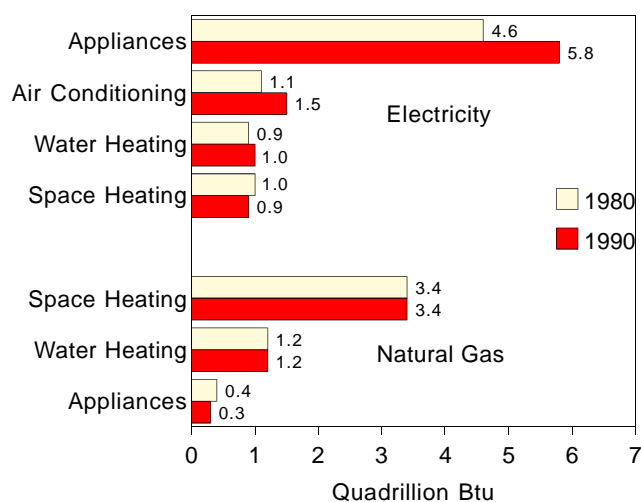
Figure 1.10. Percent of Buildings Using Major Energy Sources for Major Energy Uses in the 1980's



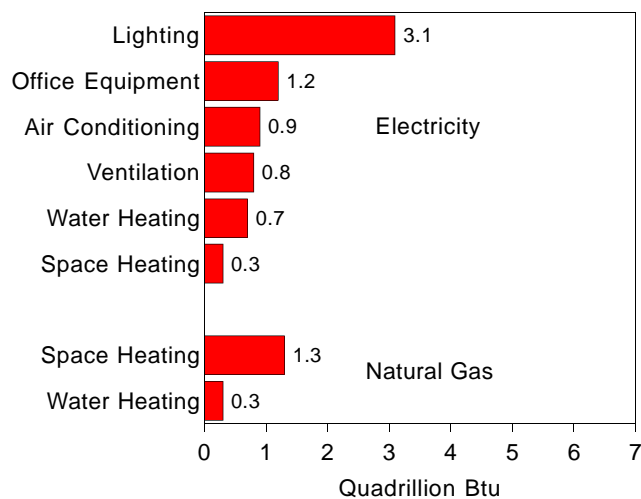
Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 1.11. Major Energy Source Consumption by End Use*

a. Residential Buildings, 1980 and 1990



b. Commercial Buildings, 1989



*Electricity consumption is primary consumption. End-use consumption estimates in commercial buildings are available only for the 1989 CBECS. Space heating and air conditioning are not adjusted for the effect of weather.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

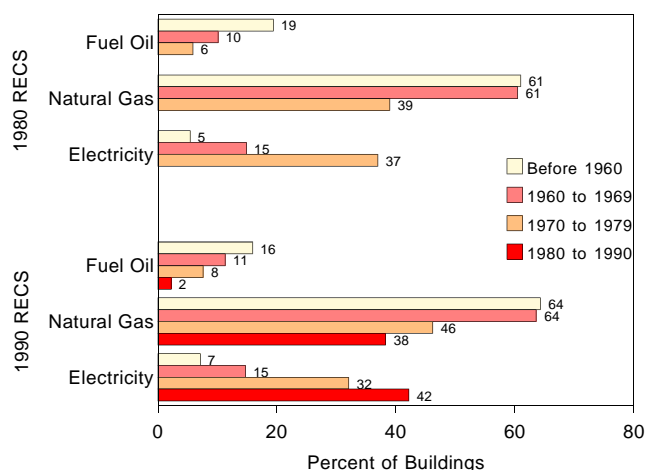
Space Heating Energy Sources and Year of Building Construction

The distribution of energy sources used for space heating by year constructed reveals interesting trends in the 1980's. These trends continued the historic rise and fall of different energy sources as the primary choices for heating buildings: first wood (which peaked in the late 1800's), then coal (which peaked during World War II), and then the three sources most commonly used today--fuel oil, natural gas, and electricity.

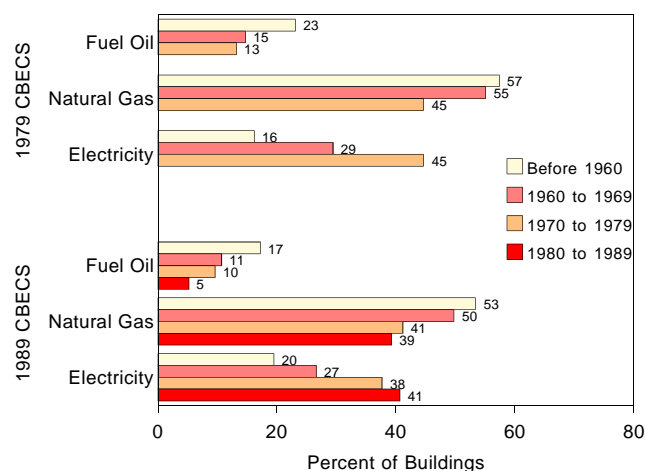
Figure 1.12. Percent of Buildings Using Major Energy Sources for Space Heating by Year Constructed

- The proportions of buildings that used electricity for space heat consistently increased from the earliest to the most recent period of construction for both residential and commercial buildings (Figures 1.12a and b).
- During the 1970's, electricity was increasingly selected for space heating in new construction, and by the beginning of the 1980's, it had risen almost to the level of natural gas use.
- The proportion of buildings using natural gas or fuel oil consistently declined from the earliest to the most recent periods of construction. That pattern held for the consumption surveys at the beginning of the decade and at the end (Figures 1.12a and b).
- The decline in the use of fuel oil for space heating mirrored its decline in use for any end uses, as well as the decline in total fuel oil consumption.

a. Residential Buildings, 1980 and 1990



b. Commercial Buildings, 1979 and 1989

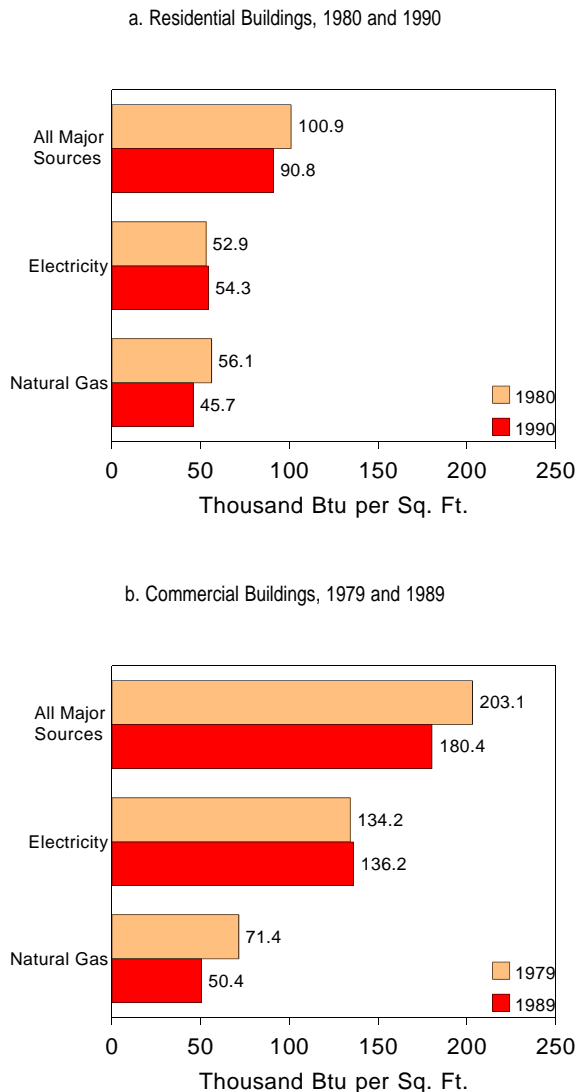


Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Trends in Energy Intensity

Total energy intensity, measured as the ratio of energy consumed to floorspace (thousand Btu per square foot of floorspace that used a particular energy source), was greater in commercial buildings than in residential buildings throughout the 1980's (Figures 1.13a and b). This reflected differences in the uses of energy and the degree of building occupancy in the two sectors. Several major commercial building types exceeded 300 thousand Btu per square foot throughout the 1980's, whereas residential buildings were dominated by single-family detached homes that had intensities less than 100 thousand Btu per square foot during the decade.

Figure 1.13. Energy Intensities by Energy Source*



* All major energy sources and electricity intensities are based on primary electricity consumption. Intensities are not adjusted for the effect of weather.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Electricity

- Electricity intensities were stable in both sectors during the decade, but the commercial intensity was more than twice as large as residential intensity (Figures 1.13a and b).

Natural Gas

- Natural gas intensities were greater in commercial buildings than in residential buildings at the beginning of the 1980's but, by the end of the decade, the intensities were not significantly different. Natural gas intensities in both groups decreased during the decade (Figures 1.13a and b).

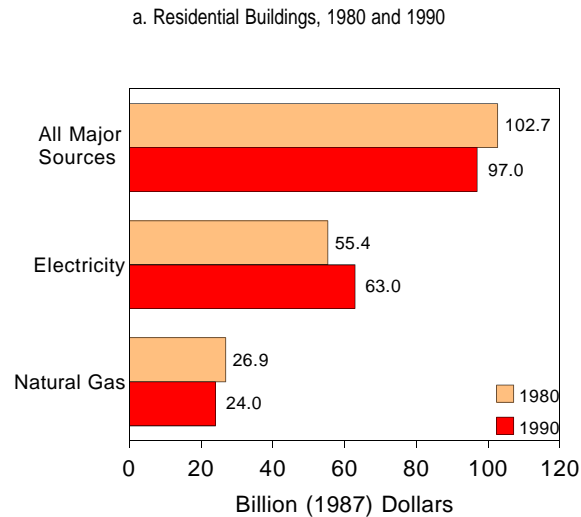
Trends in Expenditures

Total expenditures for energy in residential buildings, in real terms (1987 dollars), exceeded energy expenditures in commercial buildings during the 1980's. At the end of the decade commercial expenditures were only 67 percent of residential expenditures (Figures 1.14a and b).

Electricity

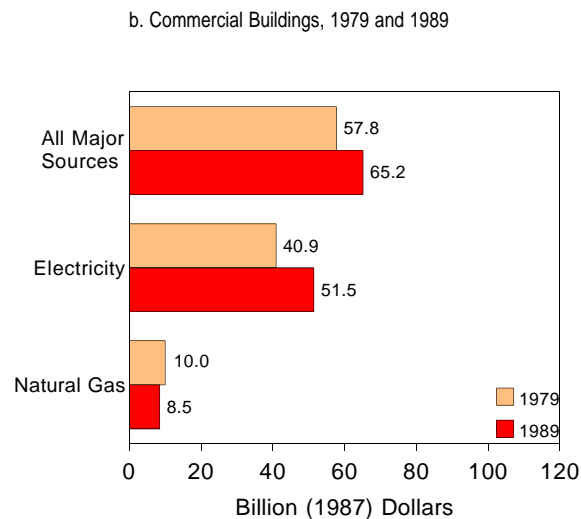
- Electricity expenditures in both sectors increased throughout the decade and exceeded those of other energy sources. Residential expenditures for electricity increased from 54 percent of total energy expenditures in 1980 to 65 percent in 1990, while in the commercial sector expenditures for electricity increased from 71 percent of total energy expenditures in 1979 to 79 percent in 1989 (Figures 1.14a and b).

Figure 1.14. Expenditures (1987 Dollars) for Energy by Energy Source*



Natural Gas

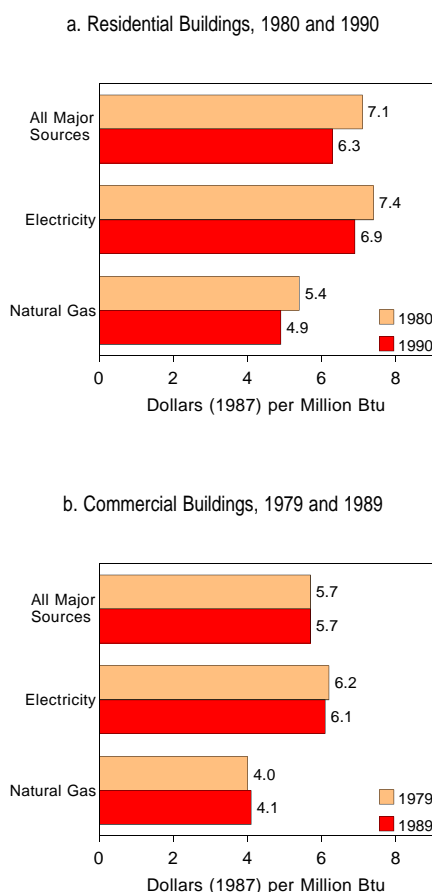
- In both sectors, natural gas expenditures were at about the same level at the beginning and end of the decade. By the end of the 1980's, natural gas expenditures were one-fourth of total expenditures in the residential sector and only one-eighth of the total in the commercial sector (Figures 1.14a and b).



*See Appendix C, "Data Quality", for adjustment to 1987 dollars.

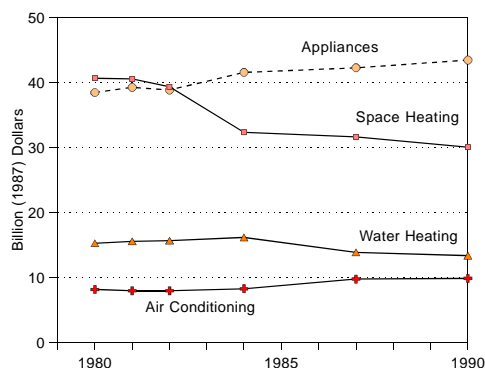
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 1.15. Expenditure Intensities by Energy Source



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 1.16. Expenditures (1987 Dollars) for End Uses in Residential Buildings in the 1980's



Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Expenditure Intensities

- Expenditure intensities (dollars expended per million Btu of energy consumed) declined during the decade in the residential sector and remained constant in the commercial sector (Figures 1.15a and b).
- At the beginning of the decade, commercial expenditure intensity was 80 percent of residential, by the end of the decade, commercial expenditure intensity was 90 percent of residential (Figures 1.15a and b).
- Electricity expenditure intensities were greater than those of natural gas in both sectors throughout the 1980's.

Expenditures for End Uses

- In the residential sector, expenditures for space heating and appliances far exceeded those for water heating and air conditioning. From 1980 to 1982, expenditures for space heating and appliances were nearly identical. They subsequently diverged as space heating expenditures declined, while expenditures for appliances rose (Figure 1.16).
- The largest single contributor to the household energy bill is now the appliance load (Figure 1.16).