Residential and Commercial Buildings Data Book

Second Edition

**L. W. Crumb
A. A. Bohn**

September 1986

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

**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
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Pacific Northwest Laboratory
Richland, Washington 99352

SUMMARY

This Data Book updates and expands the previous Data Book originally published by the Department of Energy in October, 1984 (DOE/RL/01830/16). Energy-related information is provided under the following headings:

- Characteristics of Residential Buildings in the U.S.
- Characteristics of New Single Family Construction in the U.S.
- Characteristics of New Multi-Family Construction in the U.S.
- Household Appliances
- Residential Sector Energy Consumption, Prices, and Expenditures
- Characteristics of U.S. Commercial Buildings
- Commercial Buildings Energy Consumption, Prices, and Expenditures
- Additional Buildings and Community Systems Information

This Data Book complements another Department of Energy document entitled "Overview of Building Energy Use and Report of Analysis-1985" October, 1985 (DOE/CE-0140). The Data Book provides supporting data and documentation to the report.

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CHAPTER ONE: INTRODUCTION

1.1 OVERVIEW

The possession of current and reliable information on building characteristics and energy consumption patterns is a fundamental prerequisite for effective R&D and program planning in the Office of Buildings and Community Systems (BCS). The Residential and Commercial Buildings Data Book is intended to complement other BCS information sources by compiling the most current data on the existing stock of residential and commercial buildings and their energy consumption characteristics. Most of this data is provided in tabular form with accompanying figures used to highlight key points. The Data Book also provides information on forecasts and historical trends for the residential and commercial sectors. The information contained herein was drawn from diverse sources and was compiled into a single volume in order to provide BCS staff with easier access to it.

Current plans call for this document to be updated and revised from time to time as new data become available. Accordingly, users of this data book are encouraged to submit requests, comments, and information to the Pacific Northwest Laboratory.

1.2 ORGANIZATION OF THE REPORT

This report can be divided into three basic subject areas: residential buildings, commercial buildings, and energy consumption forecasts. These subject areas are covered in the following chapters:

Residential Buildings

Chapter 2	Characteristics of U.S. Residential Building Stock
Chapter 3	Characteristics of New Single Family Construction in the U.S.
Chapter 4	Characteristics of New Multi-Family Construction in the U.S.
Chapter 5	Household Appliances
Chapter 6	Residential Sector Energy Consumption and Prices

Commercial Buildings

- Chapter 7 Characteristics of U.S. Commercial Building Stock
- Chapter 8 Commercial Buildings Sector Energy Consumption, Prices, and Expenditures

Additional Information

- Chapter 9 Additional Buildings and Community Systems Information

The complete list of data sources used in producing the Data Book is provided in Appendix A. In addition, the first page of each chapter lists the references used for the specific chapter.

1.3 THE FOUR ENERGY CONSUMPTION SECTORS

Information on total national energy consumption is frequently broken down into four end-use sectors: residential, commercial, industrial, and transportation. Tables 1.1 and 1.2 provide information on the energy consumption characteristics of these sectors over the period of 1960 through 1983. It should be noted that the information for the commercial sector includes both buildings and "nonbuilding" energy consumers. Thus the figures for total energy consumption in the commercial sector are not synonymous with energy consumption by commercial buildings alone. Chapter 8 provides information on commercial building energy consumption only and thus excludes energy consumption by nonbuilding energy consumers in the commercial sector, such as street lights, pumps, and construction sites. Figure 1.3 illustrates the division of commercial sector energy consumption into buildings and nonbuildings categories for 1979, the year covered by Chapter 8.

FIGURE 1.1 U.S. Energy Consumption, 1960 through 1983, by End-Use Sector

Year	Residential	Commercial	Industrial	Transportation	Total U.S. Consumption
1960	8,286.4	4,751.4	20,170.4	10,598.2	43,806.3
1961	8,584.0	4,847.2	20,261.5	10,772.2	44,464.9
1962	9,104.6	5,155.9	21,058.3	11,221.6	46,540.4
1963	9,371.9	5,338.3	21,973.6	11,652.8	48,336.7
1964	9,692.8	5,536.8	23,284.2	11,994.0	50,507.9
1965	10,126.0	5,906.3	24,239.9	12,423.7	52,695.9
1966	10,665.9	6,391.5	25,524.7	13,087.5	55,669.6
1967	11,151.4	6,950.3	25,748.5	13,731.1	57,581.3
1968	11,872.3	7,364.7	26,939.3	14,838.9	61,015.2
1969	12,725.9	7,864.6	28,132.3	15,480.3	64,203.1
1970	13,349.2	8,365.7	28,654.8	16,073.6	66,443.3
1971	13,880.0	8,715.4	28,601.6	16,702.2	67,899.1
1972	14,527.3	9,164.4	29,879.7	17,694.7	71,266.0
1973	14,625.0	9,525.3	31,521.4	18,595.7	74,267.4
1974	14,369.0	9,362.9	30,683.2	18,113.2	72,528.4
1975	14,456.5	9,448.6	28,399.3	18,239.8	70,544.1
1976	15,005.6	10,019.5	30,227.4	19,093.3	74,345.8
1977	15,211.9	10,172.0	31,071.2	19,808.1	76,263.2
1978	15,621.1	10,477.6	31,400.8	20,589.1	78,088.6
1979	15,198.8	10,616.9	32,808.2	20,464.1	78,888.2
1980	15,079.8	10,593.7	30,616.8	19,695.2	75,985.6
1981	14,619.3	10,653.3	29,252.5	19,496.6	74,021.6
1982	14,737.3	10,859.2	26,112.8	19,065.4	70,774.6
1983	14,736.4	10,714.3	25,910.2	19,148.7	70,507.6

Notes: These data describe total primary energy consumption in each sector. They thus include energy losses incurred in the conversion, transmission, and distribution of electricity.

Notes: Neither the use of wood-derived fuels by the industrial sector nor the use of wood as a fuel by the residential sector. In addition, energy consumed from the following energy sources has also been excluded, except where it has been consumed by electric utilities: solar, geothermal, biomass, waste, and wind energy.

Notes: The commercial sector energy consumption data represent the combined consumption of both the buildings component of that sector and the nonbuildings component. Included in the nonbuilding component of the commercial sector are street lights, bridges, pumps, swimming pools, construction sites, etc.

Sources: State Energy Data Report: Consumption Estimates, 1960 - 1983. DOE/EIA, May, 1985.

TABLE 1.1 U.S. Energy Consumption by End-Use Sector, 1960 - 1983
(Trillion Btu)

Year	Residential	Commercial	Industrial	Transportation	Annual Percentage Increase in Total U.S. Consumption
1960	18.9	10.8	46.0	24.2	0.0
1961	19.3	10.9	45.6	24.2	1.5
1962	19.6	11.1	45.2	24.1	4.7
1963	19.4	11.0	45.5	24.1	3.9
1964	19.2	11.0	46.1	23.7	4.5
1965	19.2	11.2	46.0	23.6	4.3
1966	19.2	11.5	45.9	23.5	5.6
1967	19.4	12.1	44.7	23.8	3.4
1968	19.5	12.1	44.2	24.3	6.0
1969	19.8	12.2	43.8	24.1	5.2
1970	20.1	12.6	43.1	24.2	3.5
1971	20.4	12.8	42.1	24.6	2.2
1972	20.4	12.9	41.9	24.8	5.0
1973	19.7	12.8	42.4	25.0	4.2
1974	19.8	12.9	42.3	25.0	-2.3
1975	20.5	13.4	40.3	25.9	-2.7
1976	20.2	13.5	40.7	25.7	5.4
1977	19.9	13.3	40.7	26.0	2.8
1978	20.0	13.4	40.2	26.4	2.4
1979	19.3	13.5	41.3	25.9	1.0
1980	19.8	13.9	40.3	25.9	-3.7
1981	19.8	14.4	39.5	26.3	-2.6
1982	20.8	15.3	36.9	26.9	-4.4
1983	20.9	15.2	36.7	27.2	-0.4

Notes: The percentages given for the annual increase in total energy consumption represent the percentage increase in consumption in the current year when compared with the previous year ((Year 1 - Year 0) / Year 0).

Source: State Energy Data Report: Consumption Estimates, 1960 - 1983. DOE/EIA, May, 1985.

TABLE 1.2 End-Use Sector Shares of Total U.S. Energy Consumption, 1960 - 1983

FIGURE 1.2 End-Use Sector Energy Consumption in 1960 and 1983

FIGURE 1.3 Commercial Sector Energy Consumption, by Buildings and Nonbuildings Components, 1979 (total commercial consumption equals 10,616.9 trillion Btu)

Remarks:

1. Table 1.1 lists total commercial sector energy consumption in 1979 as being 10,616.9 trillion Btu. Table 8.3 indicates that the buildings component of the commercial sector consumed 5,457 trillion Btu in 1979, 51% of the total.

1.4 THE FOUR CENSUS REGIONS

SOURCE: Annual Energy Review: 1984. U.S. DOE/EIA. April, 1985.

FIGURE 1.4 The Four Census Regions

The data in this publication have frequently been divided according to four commonly-used census regions, known as the Northeast, North Central, South, and West regions. The composition of these regions is as follows. Please note that the states of Alaska and Hawaii are not included in these regions. Data from these states were also excluded from the EIA-produced reports.

Northeast:	Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.
North Central:	Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, and South Dakota.
South:	Maryland, Delaware, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, Oklahoma, and Texas.
West:	Montana, Wyoming, Idaho, Washington, Oregon, Colorado, Utah, Nevada, California, Arizona, and New Mexico.

1.5 GROSS NATIONAL PRODUCT, POPULATION, AND NUMBER OF HOUSEHOLDS

Table 1.3 provides information on U.S. gross national product, population, and number of households for each year between 1960 and 1983. The GNP figures are given in constant 1972 dollars. Table 1.4 compares GNP with total and end-use energy consumption for the country as a whole. Information on the correlation of GNP with consumption in the residential and commercial sectors can be found in Chapter 6 and Chapter 8.

Year	Gross National Product (Billion 1972\$)	Population (millions)	Households (millions)	Population per Household	GNP per Capita (thousand \$)	GNP per Household
1960	737.2	180.0	52.8	3.41	4.10	13.96
1961	756.6	183.0	53.6	3.42	4.13	14.13
1962	800.3	185.8	54.8	3.39	4.31	14.61
1963	832.5	188.5	55.3	3.41	4.42	15.06
1964	878.4	191.1	56.2	3.40	4.59	15.61
1965	929.3	193.5	57.4	3.37	4.80	16.18
1966	984.8	195.6	58.4	3.35	5.04	16.86
1967	1,011.4	197.5	59.2	3.33	5.12	17.07
1968	1,058.1	199.4	60.8	3.28	5.31	17.40
1969	1,087.6	201.4	62.2	3.24	5.40	17.48
1970	1,085.6	204.0	63.4	3.22	5.32	17.12
1971	1,122.4	206.8	64.8	3.19	5.43	17.33
1972	1,185.9	209.3	66.7	3.14	5.67	17.78
1973	1,254.3	211.4	68.3	3.10	5.93	18.38
1974	1,246.3	213.3	69.9	3.05	5.84	17.84
1975	1,231.6	215.5	71.1	3.03	5.72	17.32
1976	1,298.2	217.6	72.9	2.99	5.97	17.82
1977	1,369.7	219.8	74.1	2.96	6.23	18.47
1978	1,438.6	222.1	76.0	2.92	6.48	18.92
1979	1,479.4	224.6	77.3	2.90	6.59	19.13
1980	1,475.0	227.2	80.8	2.81	6.49	18.26
1981	1,513.8	229.5	82.4	2.79	6.60	18.38
1982	1,485.4	231.8	83.5	2.77	6.41	17.78
1983	1,535.3	234.0	83.9	2.79	6.56	18.29

Source: Energy Conservation Indicators, 1983 Annual Report, DOE/IEA, October 1984.

TABLE 1.3 Gross National Product, Population, and Number of Households, 1960 - 1983

Year	Gross National Product (Billion 1972\$)	Total Energy Consumption (Trillion Btu)	End-Use Energy Consumption (Trillion Btu)	Total Energy per GNP Dollar (Thousand Btu)	End-Use Energy per GNP Dollar (Thousand Btu)	Yearly Change of End-Use Energy per GNP Dollar (Percent)
1960	737.2	43,741.2	37,878.8	59.3	51.4	NA
1961	756.6	44,405.4	38,382.6	58.7	50.7	-1.27
1962	800.3	46,480.7	40,085.8	58.1	50.1	-1.27
1963	832.5	48,274.2	41,474.0	58.0	49.8	-0.54
1964	876.4	50,438.4	43,149.9	57.5	49.2	-1.17
1965	929.3	52,619.2	44,846.0	56.8	48.3	-1.99
1966	984.8	55,591.7	47,117.4	56.4	47.8	-0.86
1967	1,011.4	57,506.8	48,548.6	56.9	48.0	0.33
1968	1,058.1	60,941.7	51,151.3	57.8	48.3	0.71
1969	1,087.6	64,127.0	53,418.0	59.0	49.1	1.60
1970	1,085.6	66,363.7	54,830.7	61.1	50.5	2.83
1971	1,122.4	67,831.3	55,687.3	60.4	49.6	-1.77
1972	1,185.9	71,195.0	58,109.2	60.0	49.0	-1.24
1973	1,254.3	74,192.1	60,183.0	59.2	48.0	-2.08
1974	1,248.3	72,459.3	58,254.0	58.1	46.7	-2.58
1975	1,231.6	70,478.2	56,086.3	57.2	45.5	-2.57
1976	1,298.2	74,278.3	59,032.4	57.2	45.5	-0.15
1977	1,369.7	76,202.0	60,148.0	55.6	43.9	-3.43
1978	1,438.6	78,037.8	61,187.3	54.2	42.5	-3.14
1979	1,479.4	78,829.6	61,769.0	53.3	41.8	-1.83
1980	1,475.0	75,926.9	58,543.6	51.5	39.7	-4.94
1981	1,513.8	73,978.7	56,514.7	48.9	37.3	-5.94
1982	1,485.4	70,755.5	53,653.4	47.6	36.1	-3.25
1983	1,535.3	70,515.0	52,865.0	45.9	34.4	-4.67

Notes: "Total Energy Consumption" includes energy losses incurred during the generation of electricity.
"End-Use Energy Consumption" does not incur energy losses.

Notes: The differences between "Total Energy Consumption" on this table and "Total Energy Consumption" as listed elsewhere are due to the differences reported in the 1984 and 1985 editions of the DOE/EIA "State Energy Data Report".

Sources: Energy Conservation Indicators, 1983 Annual Report, DOE/IEA, October 1984.

TABLE 1.4 Energy Consumption per Constant Dollar of Gross National Product

CHAPTER TWO: CHARACTERISTICS OF RESIDENTIAL BUILDINGS IN THE U.S.

This chapter provides general information on some energy-related characteristics of the U.S. residential sector as of 1983. Data for this chapter was taken primarily from the Annual Housing Survey; 1983, Part F, Energy-Related Housing Characteristics, Series H-150-83, 1985. This is a publication of the U.S. Department of Commerce, Bureau of the Census. At the time that this edition of the Residential and Commercial Buildings Data Book was produced this was the most current information available.

This chapter is comprised of the following sections:

<u>Section Number</u>	<u>Section Title</u>	<u>Page Number</u>
2.1	Residential Housing Types	2.2
2.2	Residential Space Heating Fuel Usage	2.4
2.3	Residential Space Heating Equipment Types	2.10
2.4	Residential Air Conditioning Equipment	2.16

2.1 RESIDENTIAL HOUSING TYPES

REGIONS	Regional Totals		Single Family Homes		Multi-Family Units		Mobile Homes and Trailers	
	# of Units	% of Region	# of Units	% of Region	# of Units	% of Region	# of Units	% of Region
Northeast	18,221	21.5	10,410	57.1	7,463	41.0	348	1.9
North Central	21,618	25.5	15,621	72.3	5,241	24.2	756	3.5
South	27,931	33.0	20,622	73.8	5,451	19.5	1,858	6.7
West	16,868	19.9	11,000	65.2	4,831	28.6	1,037	6.1
US Totals	84,638	100.0	57,653	68.1	22,986	27.2	3,999	4.7

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.1 United States Housing Stock, by Region and Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. The South contains one third of all U.S. residential units, making it the largest of the 4 census regions in this regard. 74% of all dwellings in the South are single family homes, the highest percentage in any region. 7% of the regions dwellings are mobile homes, also the highest percentage of any region. The South contains almost one half of all mobile homes in the US. The South has the lowest percentage (20%) of multi-family homes.
2. The North Central region contains approximately one quarter of all US residential units. The proportion of single family homes in this region (72%) is almost equal to the proportion in the South. In contrast to the South, however, multi-family units are more prevalent (24% of all units in the region) and mobile homes are less prevalent (4% of all units).
3. The Northeast region, with approximately one fifth of all US units, exhibits the greatest divergence from the national averages. In the Northeast single family homes account for only 57% of total units, the lowest proportion for single family units for any region. The Northeast also has the lowest proportion of mobile homes (2%). However, the Northeast does have the highest proportion of multi-family units (41%), which constitute one third of all such units in the US.
4. The West, with approximately one fifth of all US units, is the region which most closely approximates the averages for the country as a whole. Sixty-five percent of its units are single family homes; 29% are multi-family units, and 6% are mobile homes.

2.2 RESIDENTIAL SPACE HEATING FUEL USAGE

Residential Space Heating Fuel Usage in the United States

	Total U.S.		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ...	84,638		57,653		22,986		3,999	
HOUSE HEATING FUEL	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Utility Gas	46,702	55.2	33,290	57.7	11,980	52.1	1,432	35.8
Bottled, Tank, or LP Gas.....	3,869	4.6	2,815	4.9	128	0.6	926	23.2
Fuel Oil, Kerosene	13,032	15.4	8,165	14.2	4,340	18.9	527	13.2
Electricity	15,683	18.5	8,742	15.2	6,072	26.4	869	21.7
Coal or Coke	431	0.5	399	0.7	27	0.1	5	0.1
Wood	4,087	4.8	3,826	6.6	48	0.2	213	5.3
Solar Heat	25	0.03	21	0.04	4	0.02	--	--
Other Fuel	133	0.2	25	0.04	108	0.5	--	--
None.....	678	0.8	368	0.6	282	1.2	28	0.7

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.2 Residential Space Heating Fuel Usage in the United States, by Housing Type, 1983
(Number of Occupied Units, in Thousands)

FIGURE 2.1 Residential Space Heating Fuel Usage in the U.S., by Housing Type 1983

Note: The use of solar heat, other fuels, and no fuels is not specifically portrayed in Figure 2.1. Their sum is equivalent to the space between the tops of the bars and the 100% line.

Remarks:

1. Despite the popularity of electricity as a space heating fuel in new residential buildings natural gas is the predominant residential space heating fuel within the US. Fifty-five percent of all homes in the US use natural gas for space heating.
2. Electricity is the second most popular space heating fuel in the US but, with 18.5% of the homes using it, it lags far behind utility gas in popularity. Electricity is most popular in multi-family units and least popular in single family homes.
3. The combined category of bottled, tank, and LP gas is the fourth most popular fuel type. It is used by 4.6% of all dwelling units in the US for space heating. It is most popular in mobile homes, where its mark of 23% puts it second only to utility gas in popularity in that dwelling unit type. About 5% of the nation's single family homes use LP gas but less than one percent of the multifamily units do.

Space Heating Fuel Usage in the Northeast Region

	Total Northeast		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ...	18,221		10,410		7,463		348	
HOUSE HEATING FUEL	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Utility Gas	7,740	42.5	4,663	44.8	3,003	40.2	74	21.3
Bottled, Tank, or LP Gas.....	144	0.8	73	0.7	47	0.6	24	6.9
Fuel Oil, Kerosene	8,227	45.1	4,326	41.6	3,685	49.4	216	62.2
Electricity	1,319	7.2	625	6.0	680	9.1	14	4.0
Coal or Coke	213	1.2	196	1.9	16	0.2	1	0.3
Wood	546	3.0	516	5.0	12	0.2	18	5.2
Solar Heat	1	0.01	1	0.01	--	--	--	--
Other Fuel	26	0.1	9	0.1	17	0.2	--	--
None.....	6	0.03	1	0.01	5	0.1	--	--

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.3 Space Heating Fuel Usage in the Northeast by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Fuel oil or kerosene is used for space heating in 45% of all homes in the Northeast region, well above the national average of 15%. Fuel oil and kerosene are most popular in mobile homes and least popular in single family homes (62% and 42%, respectively).
2. Utility gas is the second most popular space heating fuel in the region with an incidence of 43%. This is considerably below the national average of 55% of all homes. In the Northeast, utility gas is most popular in single family homes (45%) and least popular in mobile homes (21%).
3. Wood is used by only 3% of Northeast homes; mostly in single family units.

Space Heating Fuel Usage in the North Central Region

	Total North Central		Single Family		Multi- Family		Mobil Home or Trailer	
All Occupied Housing Units ...	21,618		15,621		5,241		756	
HOUSE HEATING FUEL	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Utility Gas	15,656	72.4	11,266	72.1	4,038	77.0	352	46.5
Bottled, Tank, or LP Gas.....	1,166	5.4	942	6.0	24	0.5	200	26.4
Fuel Oil, Kerosene	1,774	8.2	1,419	9.1	275	5.2	80	10.6
Electricity	2,173	10.1	1,216	7.8	872	16.6	85	11.2
Coal or Coke	68	0.3	57	0.4	10	0.2	1	0.1
Wood	745	3.4	701	4.5	5	0.1	39	5.2
Solar Heat	4	--	4	--	--	--	--	--
Other Fuel	27	0.1	10	0.1	17	0.3	--	--
None.....	6	--	4	.0	2	--	--	--

Source: Annual Housing Survey: 1983, Part F. Energy Related Housing Characteristics.
Series H-150-83, September 1985.

TABLE 2.4 Space Heating Fuel Usage in the North Central Region,
by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Utility gas is used for space heating in 72% of all homes in the North Central region, making it the most frequently used space heating fuel in this region. This frequency is above the national average of 55% of all homes.
2. Electricity is used in 10% of North Central homes, considerably less frequently than the national incidence of 19%. Electricity is most prevalent in multi-family units.
3. Wood is used by less than 4% of the region's homes, and primarily in single family and mobile homes.

Space Heating Fuel Usage in the Southern Region

	Total South		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ...	27,931		20,622		5,451		1,858	
HOUSE HEATING FUEL	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Utility Gas	12,346	44.2	9,751	47.3	2,123	38.9	472	25.4
Bottled, Tank, or LP Gas.....	2,169	7.8	1,581	7.7	50	0.9	538	29.0
Fuel Oil, Kerosene	2,560	9.2	2,023	9.8	317	5.8	220	11.8
Electricity	8,559	30.6	5,189	25.2	2,845	52.2	525	28.3
Coal or Coke	136	0.5	133	0.6	--	--	3	0.2
Wood	1,882	6.7	1,780	8.6	17	0.3	85	4.6
Solar Heat	1	--	1	--	--	--	--	--
Other Fuel	17	0.1	4	--	13	0.2	--	--
None.....	266	1.0	162	0.8	89	1.6	15	0.8

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.5 Space Heating Fuel Usage in the Southern Region, by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Utility gas is used in 44% of all homes in the South for space heating. Although this frequency makes utility gas the most frequently used space heating fuel in that region, its incidence of use is below the national average of 55%. Electricity is used in 31% of Southern homes, considerably more frequent than the national incidence of 19%.
2. Bottled, tank, or LP gas is used in 29% of the South's mobile homes, making it the most popular fuel for that dwelling type in that region.
3. Wood is used as a space heating fuel in 7% of the region's dwellings, primarily in single family mobile homes.

Space Heating Fuel Usage in the Western Region

	Total West		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ...	16,868		11,000		4,831		1,037	
HOUSE HEATING FUEL	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Utility Gas	10,955	65.0	7,610	69.2	2,812	58.2	533	51.3
Bottled, Tank, or LP Gas.....	390	2.3	219	2.0	7	0.1	164	15.8
Fuel Oil, Kerosene	472	2.8	395	3.6	67	1.4	10	1.0
Electricity	3,633	21.5	1,712	15.6	1,675	34.7	246	23.7
Coal or Coke	17	0.1	15	0.1	2	--	--	--
Wood	915	5.4	829	7.5	15	0.3	71	6.8
Solar Heat	19	0.1	15	0.1	4	0.1	--	--
Other Fuel	65	0.4	2	--	63	1.3	--	--
None.....	400	2.4	201	1.8	185	3.8	14	1.3

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.6 Space Heating Fuel Usage in the West, by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Utility gas is used in 65% of all homes in the West for space heating, an incidence higher than the national average is 55%. Electricity is used in another 22% of Western homes, a slightly higher incidence than the national average of 19%.
2. The third most popular space heating fuel in the West is wood, which is used in 5% of the region's homes, and primarily in single family and mobile homes.
3. A little over 2% of the homes are reported as having no space heating fuel. Curiously, almost half of these homes are reported to be multi-family units.

2.3 RESIDENTIAL SPACE HEATING EQUIPMENT TYPES

	Total U.S.		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	84,638		57,653		22,986		3,999	
HEATING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Warm Air Furnace	44,319	52.4	32,475	56.3	8,625	37.5	3,219	80.5
Heat Pump	2,172	2.6	1,706	3.0	441	1.9	25	0.6
Steam or Hot Water	13,773	16.3	6,461	11.2	7,299	31.7	13	0.3
Built-In Electric	6,207	7.3	3,072	5.3	3,019	13.1	116	2.9
Floor, Wall or Pipeless Furnace	5,976	7.1	4,076	7.1	1,747	7.6	153	3.8
Room Heater with Flue	3,440	4.1	2,450	4.2	918	4.0	72	1.8
Room Heater without Flue	2,926	3.5	2,412	4.2	421	1.8	93	2.3
Fireplace, Stove, or Portable Heater	5,153	6.1	4,634	8.0	237	1.0	282	7.0
None	678	0.8	368	0.6	282	1.2	28	0.7

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.7 Residential Sector Heating Equipment, by Housing Type
(Number of Occupied Units in the U.S., in Thousands)

FIGURE 2.2 Residential Space Heating Equipment, U.S. Stock, 1983

FIGURE 2.3 Residential Space Heating Equipment, by Housing Type, 1983

Note: The gap between the bars in Figure 2.7 and the 100% line is represents the percentage of U.S. households which use either fireplaces, wood stoves, portable heaters, or no heating equipment.

Remarks:

1. Warm air furnaces are the predominant type of residential heating equipment in the US. They are used in a majority (52%) of all homes in the US and are the most popular type of equipment in each of the three categories of housing type. They are most frequently found in mobile homes, where 81% of all such units use warm air furnaces. Warm air furnaces are least frequently found in multi-family units, where they have an incidence of 38%, only slightly ahead of built-in electric equipment. Warm air furnaces are used in 56% of all single family homes in the US.
2. Steam or hot water equipment, the second most popular type of space heating equipment in the US, lags far behind warm air furnaces in popularity, with an incidence of only 16% overall. This type of equipment is most popular in multi-family units, where 32% of such units use it.
3. Although heat pumps have become popular in new residential construction they are currently used in only 3% of all residential units in the US, and predominantly in single family homes.
4. Wood-burning equipment is combined with portable electric heaters into a single equipment category. Six percent of the homes use such equipment. These tend to be single family and mobile homes.

Space Heating Equipment Usage in the Northeast Region

	Total Northeast		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	18,221		10,410		7,463		348	
HEATING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Warm Air Furnace	6,501	35.7	4,544	43.7	1,658	22.2	299	85.7
Heat Pump	118	0.6	97	0.9	20	0.3	1	0.3
Steam or Hot Water	9,191	50.4	4,417	42.4	4,762	63.8	12	3.4
Built-In Electric	1,110	6.1	482	4.6	622	8.3	6	1.7
Floor, Wall or Pipeless Furnace	158	0.9	125	1.2	28	0.4	5	1.4
Room Heater with Flue	410	2.2	134	1.3	269	3.6	7	2.0
Room Heater without Flue	55	0.3	21	0.2	33	0.4	1	0.3
Fireplace, Stove, or Portable Heater	675	3.7	589	5.7	68	0.9	18	5.2
None	6	--	1	--	5	0.1	--	--

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.8 Space Heating Equipment in the Northeast, by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Warm air furnaces in the Northeast are not the predominant type of heating equipment, distinguishing this region from the others. Warm air furnaces are used in 36% of all homes in the region, however, and are second in popularity only to steam or hot water equipment, which is found in 50% of the region's homes.
2. Steam or hot water equipment is the most popular type of space heating equipment in the Northeast. The Northeast is one of only two regions in which this equipment type has an important degree of penetration, the North Central region being the other. Steam or hot water equipment is most frequent in multi-family units (64%).
3. Built-in electric equipment is the third most frequent type of space heating equipment in the Northeast (6%). This equipment is most frequently found in multi-family units.

Space Heating Equipment Usage in the North Central Region

	Total North Central		Single Family		Multi- Family		Mobil Home or Trailer	
All Occupied Housing Units ..	21,618		15,621		5,241		756	
HEATING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Warm Air Furnace	14,900	68.9	11,798	75.5	2,451	46.7	651	85.9
Heat Pump	275	1.3	243	1.6	30	0.6	2	0.3
Steam or Hot Water	3,006	13.9	1,209	7.7	1,796	34.3	1	0.1
Built-In Electric	1,272	5.9	636	4.1	617	11.8	19	2.5
Floor, Wall or Pipeless Furnace	458	2.1	347	2.2	82	1.6	29	3.8
Room Heater with Flue	782	3.6	565	3.6	207	3.9	10	1.3
Room Heater without Flue	91	0.4	43	0.3	45	0.9	3	0.4
Fireplace, Stove, or Portable Heater	832	3.8	776	5.0	13	0.2	43	5.7
None	6	--	4	--	2	--	--	--

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics,
Series H-150-83, September 1985.

TABLE 2.9 Space Heating Equipment in the North Central Region,
by Housing Type, 1983

Remarks:

1. Warm air furnaces are the predominant type of heating equipment in the US and in every region except the Northeast. It is in the North Central region, however, where 69% of all the homes have them, that they are most frequently used. They are used most frequently in mobile homes (86%) and single family homes (76%). Forty seven percent of the multi-family units in the region use warm air furnaces.
2. Steam or hot water equipment is the second most popular type of space heating equipment in the North Central region, with 14% of all homes using it. The North Central region is one of only two regions in which this equipment type has a significant penetration, the other one being the Northeast.

Space Heating Equipment Usage in the Southern Region

	Total South		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	27,931		20,622		5,451		1,858	
HEATING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Warm Air Furnace	14,476	51.8	9,901	48.0	3,118	57.2	1,457	78.4
Heat Pump	1,406	5.0	1,078	5.2	311	5.7	17	0.9
Steam or Hot Water	988	3.5	626	3.0	362	6.6	0	0.0
Built-In Electric	1,891	6.8	1,236	6.0	591	10.8	64	3.4
Floor, Wall or Pipeless Furnace	2,002	7.2	1,625	7.9	312	5.7	65	3.5
Room Heater with Flue	1,702	6.1	1,399	6.8	265	4.9	38	2.0
Room Heater without Flue	2,655	9.5	2,273	11.0	307	5.6	75	4.0
Fireplace, Stove, or Portable Heater	2,547	9.1	2,322	11.3	98	1.8	127	6.8
None	266	1.0	162	0.8	89	1.6	15	0.8

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.10 Space Heating Equipment in the South, by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Warm air furnaces are the predominant type of heating equipment in the South. They are used in a majority (52%) of all homes and are the most popular type of equipment in each of the three categories of housing.
2. Steam or hot water equipment, although the second most popular type of space heating equipment in the US overall, is used in only 4% of all homes in the South.
3. Heat pumps are used for space heating in a total of 5% of all homes in the South, making the South the region with the highest proportionate and absolute incidence of heat pumps. The South has approximately two thirds of all residential heat pumps in use in the US.
4. The use of wood-burning equipment and portable heaters is also most prevalent in the South, where 9% of all homes report using such equipment. Room heaters are also much more prevalent here than in other regions.

Space Heating Equipment Usage in the Western Region

	Total West		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	16,868		11,000		4,831		1,037	
HEATING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
Warm Air Furnace	8,446	50.1	6,232	56.7	1,401	29.0	813	78.3
Heat Pump	373	2.2	288	2.6	80	1.7	5	0.5
Steam or Hot Water	589	3.5	208	1.9	381	7.9	--	--
Built-In Electric	1,935	11.5	718	6.5	1,190	24.6	27	2.6
Floor, Wall or Pipeless Furnace	3,359	19.9	1,980	18.0	1,325	27.4	54	5.2
Room Heater with Flue	543	3.2	351	3.2	176	3.6	16	1.5
Room Heater without Flue	124	0.7	74	0.7	36	0.7	14	1.3
Fireplace, Stove, or Portable Heater	1,100	6.5	948	8.6	57	1.2	95	9.2
None	400	2.4	201	1.8	185	3.8	14	1.3

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.11 Space Heating Equipment in the West, by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Warm air furnaces are used in half of all homes in the West. They are most frequently found in mobile homes (78%) and single family homes (57%). They are least frequently found in multi-family units, where they have an incidence of 29%, only slightly ahead of floor, wall, or pipeless furnaces (27%) and built-in electric equipment (25%).
2. Although steam or hot water equipment is the second most popular type of space heating equipment in the US with an incidence of 16%, it is only used in 4% of all homes in the West. Heat pumps are also slightly less popular in the West than in the US overall.
3. Less than three percent of all homes in the West (400,000 units) report having no space heating equipment. This relatively small number of homes accounts for almost two thirds of all such homes in the country, however. Of the other three regions only the South report having a substantial number of such homes (266,000).

2.4 RESIDENTIAL AIR CONDITIONER EQUIPMENT USAGE

	Total U.S.		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	84,638		57,653		22,986		3,999	
AIR CONDITIONING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
With Air Conditioning	50,008	59.1	34,811	60.4	12,642	55.0	2,555	63.9
Room Units	25,328	29.9	17,158	29.8	6,873	29.9	1,297	32.4
1	16,886	20.0	10,736	18.6	5,085	22.1	1,065	26.6
2	6,257	7.4	4,624	8.0	1,417	6.2	216	5.4
3	1,594	1.9	1,276	2.2	306	1.3	12	0.3
4	395	0.5	344	0.6	48	0.2	3	0.1
5 or more.....	194	0.2	177	0.3	16	0.1	1	.0
Central System	24,678	29.2	17,653	30.6	5,767	25.1	1,258	31.5
With No Air Conditioning	34,631	40.9	22,842	39.6	10,344	45.0	1,445	36.1

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.12 Residential Air Conditioning Equipment in the U.S., by Housing Type, 1983
(Number of Occupied Units, in Thousands)

FIGURE 2.4 Residential Air Conditioning Equipment in the U.S., by Housing Type, 1983

Remarks:

1. Thirty percent of all homes in the US have one or more room air conditioners. Another 29% of all US homes have central air conditioning, bringing the total number of air conditioned homes in the US to 50,008,000, or 59% of all homes.
2. Single family and mobile homes in the US as a whole are split almost exactly evenly between room and central air conditioning. In multi-family units room air conditioners (30%) are more frequent than central air conditioning (25%).
3. Mobile homes are the type of dwelling unit most frequently air conditioned in the US (64%). Multi-family units are the type least frequently air conditioned (55%). Sixty percent of all US single family homes are air conditioned.

Air Conditioner Equipment Usage in the Northeast Region

	Total Northeast		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	18,221		10,410		7,463		348	
AIR CONDITIONING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
With Air Conditioning	8,528	46.8	5,056	48.6	3,345	44.8	127	36.4
Room Units	6,786	37.2	3,918	37.6	2,767	37.1	101	28.9
1	3,956	21.7	2,115	20.3	1,758	23.5	83	23.8
2	1,950	10.7	1,151	11.1	780	10.4	19	5.4
3	624	3.4	432	4.1	192	2.6	--	--
4	171	0.9	141	1.4	30	0.4	--	--
5 or more.....	87	0.5	79	0.8	8	0.1	--	--
Central System	1,745	9.6	1,138	10.9	580	7.8	27	7.7
With No Air Conditioning	9,695	53.2	5,355	51.4	4,119	55.2	221	63.3

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.13 Air Conditioning Equipment in the Northeast,
by Housing Type, 1983

Remarks:

- Forty seven percent of all homes in the Northeast region have some kind of air conditioning; an incidence below the national average of 59%. Only the West has a lower incidence of air conditioning (37%).
- In the Northeast, room air conditioners are much more common than central air conditioning for each type of dwelling unit. Overall, 37% of the homes in the Northeast have room air conditioning while only 10% have central air conditioning.

Air Conditioner Equipment Usage in the North Central Region

	Total North Central		Single Family		Multi- Family		Mobil Home or Trailer	
All Occupied Housing Units ..	21,618		15,621		5,241		756	
AIR CONDITIONING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
With Air Conditioning	13,341	61.7	9,796	62.7	3,078	58.7	467	61.7
Room Units	6,968	32.2	4,732	30.3	1,975	37.7	261	34.5
1	5,180	24.0	3,350	21.4	1,605	30.6	225	29.7
2	1,473	6.8	1,121	7.2	321	6.1	31	4.1
3	259	1.2	210	1.3	45	0.9	4	0.5
4	36	0.2	30	0.2	6	0.1	--	--
5 or more.....	24	0.1	21	0.1	2	--	1	0.1
Central System	6,373	29.5	5,063	32.4	1,103	21.0	207	27.3
With No Air Conditioning	8,276	38.3	5,825	37.3	2,162	41.3	289	38.2

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.14 Air Conditioning Equipment in the North Central Region,
by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Sixty two percent of the homes in the North Central region have air conditioning, an incidence slightly above the national average of 59%. Only the South region has a higher incidence of air conditioners.
2. Overall, room air conditioners are slightly more common in the region than central air conditioning. However, when broken down by dwelling unit type, central air conditioning is slightly more frequent for single family homes (32% versus 30%) while room air conditions are considerably more frequent for multi-family units and mobile homes.
3. Central air conditioning was most common in the single family homes (32%) and least common in multi-family units (21%). Twenty seven percent of the mobile homes had central air conditioning.

Air Conditioning Equipment Usage in the Southern Region

	Total South		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	27,931		20,622		5,451		1,858	
AIR CONDITIONING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
With Air Conditioning	21,857	78.3	15,965	77.4	4,440	81.5	1,452	78.1
Room Units	9,167	32.8	7,174	34.8	1,260	23.1	733	39.5
1	5,729	20.5	4,209	20.4	934	17.1	586	31.5
2	2,523	9.0	2,120	10.3	261	4.8	142	7.6
3	665	2.4	609	3.0	51	0.9	5	0.3
4	175	0.6	162	0.8	13	0.2	--	--
5 or more.....	74	0.3	74	0.4	--	--	--	--
Central System	12,689	45.4	8,790	42.6	3,180	58.3	719	38.7
With No Air Conditioning	6,074	21.7	4,657	22.6	1,011	18.5	406	21.9

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.15 Air Conditioning Equipment in the South, by Housing Type, 1983

Remarks:

1. Seventy eight percent of the homes in the South have air conditioning, giving this region the highest incidence of air conditioning, well above the national average of 59%.
2. Unlike the Northeast and North Central regions, central air conditioning is more common than room air conditioners in the South. When broken down by dwelling unit type this holds true for both single and multi-family housing. Mobile homes, however, are about evenly split between the two types.

Air Conditioning Equipment Usage in the Western Region

	Total West		Single Family		Multi-Family		Mobil Home or Trailer	
All Occupied Housing Units ..	16,868		11,000		4,831		1,037	
AIR CONDITIONING EQUIPMENT	#	% of Total	#	% of SF	#	% of MF	#	% of MH
With Air Conditioning	6,281	37.2	3,995	36.3	1,777	36.8	509	49.1
Room Units	2,408	14.3	1,333	12.1	872	18.1	203	19.6
1	2,019	12.0	1,062	9.7	785	16.2	172	16.6
2	317	1.9	231	2.1	61	1.3	25	2.4
3	49	0.3	25	0.2	21	0.4	3	0.3
4	14	0.1	11	0.1	--	--	3	0.3
5 or more.....	10	0.1	3	--	7	0.1	--	--
Central System	3,876	23.0	2,663	24.2	907	18.8	306	29.5
With No Air Conditioning	10,585	62.7	7,005	63.7	3,052	63.2	528	50.9

Source: Annual Housing Survey: 1983, Part F, Energy Related Housing Characteristics, Series H-150-83, September 1985.

TABLE 2.16 Air Conditioning Equipment in the West, by Housing Type, 1983
(Number of Occupied Units, in Thousands)

Remarks:

1. Only 37% of the homes in the West have air conditioning, giving this region the lowest regional incidence of air conditioning, well below the national average of 59%.
2. Like the South and unlike the Northeast and North Central regions, central air conditioning is more common than room air conditioners in the West.
3. Mobile homes are have the greatest frequency of air conditioning (49%). The other two dwelling unit types are considerably lower (about 36%).
4. Central air conditioning was most common in mobile homes (49%) and least common in multi-family units (19%). Twenty four percent of the single family homes had central air conditioning.

Air Conditioning Equipment Usage in the Western Region

Type of Dwelling	Number of Units	Percentage of Total	Air Conditioning Equipment	Percentage of Total	Number of Units	Percentage of Total	Air Conditioning Equipment	Percentage of Total	Number of Units	Percentage of Total	Air Conditioning Equipment	Percentage of Total
Single-family detached	10,000	10.0%	1,000	10.0%	10,000	10.0%	1,000	10.0%	10,000	10.0%	1,000	10.0%
Single-family attached	5,000	5.0%	500	10.0%	5,000	5.0%	500	10.0%	5,000	5.0%	500	10.0%
Multi-family detached	2,000	2.0%	200	10.0%	2,000	2.0%	200	10.0%	2,000	2.0%	200	10.0%
Multi-family attached	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%
Commercial	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%
Industrial	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%
Government	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%
Other	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%	1,000	1.0%	100	10.0%
Total	20,000	20.0%	2,000	10.0%	20,000	20.0%	2,000	10.0%	20,000	20.0%	2,000	10.0%

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, 1967, Table 1001, "Air Conditioning Equipment in the West by Housing Type, 1967".

TABLE 10.1 Air Conditioning Equipment in the West by Housing Type, 1967
(Number of Occupied Units, in thousands)

Notes: 1. Only 0.2% of the homes in the West have air conditioning, giving this region the lowest regional incidence of air conditioning, well below the national average of 3.2%. 2. The South and North Central regions have the highest incidence of air conditioning, with the South at 4.8% and the North Central region at 4.2%. 3. Mobile homes have the greatest frequency of air conditioning (4.0%), but the other two dwelling unit types are considerably lower (about 3.2%). 4. Central air conditioning was most common in mobile homes (4.0%) and least common in multi-family units (1.0%). Twenty-four percent of the single-family homes had central air conditioning.

CHAPTER THREE: CHARACTERISTICS OF NEW SINGLE FAMILY CONSTRUCTION IN THE U.S

This chapter provides general information on energy-related characteristics of single family homes constructed in the U.S. between 1973 and 1984. Data for this chapter was taken primarily from various issues of Characteristics of New Housing, an annual publication of the Bureau of the Census. At the time that this edition of the Residential and Commercial Buildings Data Book was produced, information on new construction was available only through 1984.

This chapter is comprised of the following sections:

<u>Section Number</u>	<u>Section Title</u>	<u>Page Number</u>
3.1	Single and Multi-Family Construction in the U.S.	3.2
3.2	Regional Distribution of New Single Family Homes	3.4
3.3	Square Feet of Floor Space in New Single Family Homes	3.6
3.4	Space Heating Fuels Used in New Single Family Homes	3.10
3.5	Space Heating Systems in New Single Family Homes	3.20
3.6	Central Air Conditioning in New Single Family Homes	3.26

3.1 NEW SINGLE AND MULTI-FAMILY CONSTRUCTION IN THE U.S.

Single Family Homes			Multi-Family Units		Multi-Family Buildings	
Year	#	% of all units	#	% of all units	#	% of all units
1973	1,197	57.0%	903	43.0%	94	7.9%
1974	940	54.4%	788	45.6%	78	8.3%
1975	875	66.4%	442	33.6%	46	5.3%
1976	1,034	75.1%	343	24.9%	48	4.6%
1977	1,258	75.9%	399	24.1%	58	4.6%
1978	1,369	73.3%	498	26.7%	73	5.3%
1979	1,301	69.5%	570	30.5%	78	6.0%
1980	957	63.7%	545	36.3%	74	7.7%
1981	819	64.7%	447	35.3%	64	7.8%
1982	632	62.8%	374	37.2%	47	7.4%
1983	924	66.4%	467	33.6%	60	6.5%
1984	1,025	62.0%	627	38.0%	75	7.3%
Totals:	12,331	65.8%	6,403	34.2%	795	6.4%

Source: Characteristics of New Housing. Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.1 New Residential Construction in the U.S., 1973 through 1984
(in Thousands)

FIGURE 3.1 New Residential Construction in the U.S., 1973 - 1984

Remarks:

1. Residential construction has fluctuated dramatically over the past decade. In 1978, the construction of single family homes peaked at 1,369,000 units. Four years later the number of new units constructed fell to 632,000, a decline of 54%.
2. Although Figure 3.1 shows little apparent fluctuation in the construction of new multi-family buildings, this is due primarily to the scale of the figure. The proportionate fluctuation in the construction of new multi-family buildings has been very similar to that for new single family units.
3. The percentage of new multi-family units to total new units has fluctuated considerably during the period portrayed. Multi-family units have constituted as much as 45% of the total units constructed (in 1974) and as little as 24% (in 1977). Since 1980 the share of multi-family units has remained relatively steady at around 35% of all new units.

3.2 REGIONAL DISTRIBUTION OF NEW SINGLE FAMILY HOMES

	U.S.		Northeast		North Central		South		West	
Year	#		#	%	#	%	#	%	#	%
1966	319		50	15.7%	77	24.1%	140	43.9%	53	16.6%
1967	764		110	14.4%	178	23.3%	329	43.1%	147	19.2%
1968	797		118	14.8%	197	24.7%	332	41.7%	149	18.7%
1969	714		104	14.6%	154	21.6%	316	44.3%	140	19.6%
1970	745		95	12.8%	161	21.6%	341	45.8%	148	19.9%
1971	1,000		126	12.6%	207	20.7%	450	45.0%	217	21.7%
1972	1,160		147	12.7%	235	20.3%	533	45.9%	242	20.9%
1973	1,197		156	13.0%	262	21.9%	526	43.9%	253	21.1%
1974	940		132	14.0%	220	23.4%	397	42.2%	191	20.3%
1975	875		114	13.0%	218	24.9%	362	41.4%	182	20.8%
1976	1,034		121	11.7%	271	26.2%	410	39.7%	232	22.4%
1977	1,258		135	10.7%	300	23.8%	512	40.7%	311	24.7%
1978	1,369		141	10.3%	300	21.9%	571	41.7%	357	26.1%
1979	1,301		135	10.4%	294	22.6%	535	41.1%	337	25.9%
1980	957		100	10.4%	170	17.8%	455	47.5%	233	24.3%
1981	819		87	10.6%	140	17.1%	408	49.8%	183	22.3%
1982	632		79	12.5%	92	14.6%	340	53.8%	121	19.1%
1983	924		106	11.5%	142	15.4%	476	51.5%	200	21.6%
1984	1,025		129	12.6%	156	15.2%	508	49.6%	233	22.7%
Totals:	17,830		2,185	12.3%	3,774	21.2%	7,941	44.5%	3,929	22.0%

Source: Characteristics of New Housing. Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.2 New Single Family Housing, by Region, 1960 - 1984
(Number of Units, in Thousands)

FIGURE 3.2 Number of New Single Family Homes, by Region, 1966 - 1984

Remarks:

1. The South has had the predominant share of single family home construction throughout the period covered (1966 - 1984). That share, which stayed between 40% and 46% of total construction through the 1970's, jumped dramatically to above 50% in the 1980's. Because of the preponderance of the South, national and Southern trends tend to closely coincide.
2. All regions other than the South have seen their shares of single family home construction diminish since the mid-1970's. However, the West and the Northeast have begun to increase their percentage shares during the 1980's. The North Central Region, which declined the furthest, going from a 26% share to a 15% share, has leveled off but has not demonstrated any new growth.

3.3 SQUARE FEET OF FLOOR SPACE IN NEW SINGLE FAMILY HOMES

Year	Total # of Houses	Less Than 1,000 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. to 1,599 Sq. Ft.		1,600 Sq. Ft. to 2,399 Sq. Ft.		2,400 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	1,197	91	8	199	17	371	31	398	33	139	12
1974	940	64	7	158	17	273	29	323	34	122	13
1975	875	74	8	146	17	260	30	301	34	95	11
1976	1,034	70	7	156	15	300	29	381	37	128	12
1977	1,258	67	5	181	14	372	30	475	38	164	13
1978	1,369	66	5	180	13	384	28	543	40	196	14
1979	1,301	68	5	175	13	363	28	496	38	199	15
1980	957	64	7	137	14	281	29	330	35	145	15
1981	819	70	9	125	15	238	29	261	32	124	15
1982	632	57	9	104	16	188	30	188	30	95	15
1983	924	71	8	130	14	285	31	299	33	138	15
1984	1,025	60	6	137	13	312	30	345	33	171	17

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census various issues.

TABLE 3.3 Average Square Feet of Floor Space Per Unit in New Single Family Homes
United States, 1973 - 1984
(Number of Houses, in Thousands)

Year	Total # of Houses	Less Than 1,000 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. to 1,599 Sq. Ft.		1,600 Sq. Ft. to 2,399 Sq. Ft.		2,400 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	156	20	13	28	18	44	28	45	29	19	12
1974	132	17	13	26	20	34	26	41	31	14	11
1975	114	13	12	24	21	32	28	34	30	11	10
1976	121	14	12	21	17	32	26	41	34	13	11
1977	135	14	10	22	17	35	26	47	35	16	12
1978	141	12	8	23	16	33	24	52	36	22	15
1979	135	9	7	17	13	34	25	49	36	26	20
1980	100	7	7	14	14	26	26	36	36	17	17
1981	87	9	11	11	13	20	23	30	34	17	19
1982	79	11	14	11	14	18	22	25	32	15	19
1983	106	8	8	14	13	28	26	37	35	19	18
1984	129	9	7	16	12	34	27	42	33	27	21

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census various issues.

TABLE 3.4 Average Square Feet of Floor Space Per Unit in New Single Family Homes
Northeast Region, 1973 - 1984
(Number of Houses, in Thousands)

Year	Total # of Houses	Less Than 1,000 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. to 1,599 Sq. Ft.		1,600 Sq. Ft. to 2,399 Sq. Ft.		2,400 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	262	26	10	53	20	80	31	74	28	29	11
1974	220	15	7	45	21	64	29	67	30	29	13
1975	218	20	9	44	20	65	30	71	32	18	8
1976	271	22	8	53	20	76	28	85	31	34	13
1977	300	17	6	57	19	86	29	108	36	33	11
1978	300	17	6	48	16	83	28	111	37	42	14
1979	294	18	6	49	17	79	27	105	35	43	15
1980	170	16	9	31	19	46	27	51	29	26	15
1981	140	18	13	23	16	39	28	38	27	22	16
1982	92	12	13	20	22	24	26	22	23	15	16
1983	142	14	10	26	19	37	26	39	27	26	18
1984	156	12	8	24	16	41	26	48	30	30	20

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census various issues.

TABLE 3.5 Average Square Feet of Floor Space Per Unit in New Single Family Homes
North Central Region, 1973 - 1984
(Number of Houses, in Thousands)

Year	Total # of Houses	Less Than 1,000 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. to 1,599 Sq. Ft.		1,600 Sq. Ft. to 2,399 Sq. Ft.		2,400 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	526	32	6	80	15	167	32	191	36	55	11
1974	397	23	6	56	14	111	28	151	38	57	14
1975	362	27	7	51	14	102	28	136	38	47	13
1976	410	22	5	61	12	112	27	171	42	54	13
1977	512	20	4	62	12	154	30	204	40	73	14
1978	571	20	4	60	11	164	29	244	42	83	15
1979	535	18	3	60	11	160	30	226	40	81	15
1980	454	22	5	60	13	140	31	167	37	65	14
1981	409	25	6	65	16	130	32	132	32	57	14
1982	339	23	7	55	16	114	34	100	29	47	14
1983	477	31	6	64	13	157	33	158	33	67	14
1984	509	27	5	70	14	161	32	175	34	76	15

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census various issues.

TABLE 3.6 Average Square Feet of Floor Space Per Unit in New Single Family Homes
Southern Region, 1973 - 1984
(Number of Houses, in Thousands)

Year	Total # of Houses	Less Than 1,000 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. to 1,599 Sq. Ft.		1,600 Sq. Ft. to 2,399 Sq. Ft.		2,400 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	253	13	5	38	15	80	32	87	34	35	14
1974	190	9	5	31	16	65	34	63	33	22	12
1975	183	14	8	28	15	61	33	60	33	20	11
1976	231	12	5	31	13	79	34	83	36	26	11
1977	312	16	5	40	13	97	31	117	38	42	13
1978	357	18	5	49	14	104	29	137	38	49	14
1979	337	23	7	49	15	90	27	127	38	48	14
1980	233	19	8	32	14	69	30	76	33	37	16
1981	184	18	10	27	15	49	27	62	34	28	15
1982	122	12	10	17	14	32	26	42	34	19	16
1983	200	18	9	27	14	63	32	66	33	26	13
1984	232	12	5	27	12	75	32	81	35	37	16

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census various issues.

TABLE 3.7 Average Square Feet of Floor Space Per Unit in New Single Family Homes Western Region, 1973 - 1984
(Number of Houses, in Thousands)

FIGURE 3.3 Number of New SF Homes by Square Footage Category 1973 - 1984, Numbers in Thousands

FIGURE 3.4 Percentage Distribution of New Single Family Homes by Square Footage Category

Remarks:

1. Two categories of house size have been predominant over the 1973 - 1984 time period: 1,200 to 1,599 square feet and 1,600 to 2,399 square feet. These two categories have accounted for a combined share of over 60% of all new houses.
2. The shares of the two smallest categories of houses (Less than 1,000 square feet and 1,000 to 1,199 square feet) vary inversely with changes in overall number of units constructed, indicating that, during slumps in single family construction, there is a tendency to build smaller houses as well to build fewer ones.
3. The percentage of new homes in the 1,600 to 2,399 square feet category varies directly with changes in the number of overall units constructed. The shares of the two remaining categories, 1,200 to 1,599 square feet and 2,400 square feet or more, appear to be unaffected by changes in the number of total units constructed.

3.4 SPACE HEATING FUELS USED IN NEW SINGLE FAMILY HOMES

Space Heating Fuels Used in New Single Family Homes in the U.S.

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1966	319	63	20	205	64	42	13	10	3
1967	764	153	20	506	66	86	11	19	3
1968	797	173	22	516	65	92	11	16	2
1969	714	180	25	457	64	66	9	9	1
1970	745	210	28	466	62	59	8	11	1
1971	1,000	305	30	600	60	81	8	14	1
1972	1,160	417	36	625	54	92	8	11	1
1973	1,197	497	42	560	47	125	10	16	1
1974	940	458	49	385	41	85	9	11	1
1975	875	429	49	347	40	82	9	18	2
1976	1,034	499	48	407	39	110	11	19	2
1977	1,258	635	50	476	38	120	9	28	2
1978	1,369	710	52	511	37	109	8	40	3
1979	1,301	662	51	512	39	86	7	41	3
1980	957	482	50	394	41	29	3	52	5
1981	819	407	50	339	41	16	2	57	7
1982	632	315	50	252	40	17	3	48	8
1983	924	448	49	400	43	22	2	53	6
1984	1,025	492	48	460	45	24	2	49	5

Source: Characteristics of New Housing, Construction Reports, Series C25,
Bureau of the Census, various issues.

TABLE 3.8 Space Heating Fuels Used in New Single Family Homes
United States, 1966 - 1984
(Number of Units, in Thousands)

FIGURE 3.5 Space Heating Fuels Used In New Single Family Homes, United States, 1966 - 1984

Remarks:

1. In the late 1960's, natural gas was the predominant fuel used for space heating in new single family homes. After 1970, however, electricity's share grew rapidly. By 1974, electricity surpassed natural gas as the most popular fuel. The popularity of electricity peaked in the late 1970's. Since that time gas has begun to slowly regain some of its lost position.
2. The increase in the use of electricity as a space heating fuel occurs in all of the four regions. However, it is the South, both because of the size of that region and because of the extremity of the switch from gas to electricity which occurs there, that is responsible for making electricity the most popular fuel in new single family homes.
3. The use of fuel oil in new single family homes has declined dramatically since 1978. Only in the Northeast is fuel oil use common enough to show up in the tables.

Space Heating Fuels Used in New Single Family Homes in the Northeast

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1966	50	6	13	24	48	18	36	2	4
1967	110	14	13	62	56	31	28	3	3
1968	118	18	15	60	51	39	33	2	2
1969	104	20	19	50	49	32	31	1	1
1970	95	23	24	41	43	30	31	1	1
1971	126	30	24	52	42	42	33	2	1
1972	147	43	29	54	36	49	33	1	1
1973	156	44	28	53	34	55	35	5	3
1974	132	51	38	38	29	42	32	1	1
1975	114	37	33	27	24	47	41	3	3
1976	121	38	31	18	15	62	51	4	3
1977	135	42	31	22	17	67	49	5	3
1978	141	48	34	23	16	60	42	11	8
1979	135	47	35	32	24	49	36	7	5
1980	100	36	36	35	35	17	17	11	11
1981	87	34	39	30	35	11	13	12	14
1982	79	27	34	28	36	14	18	10	12
1983	106	38	36	40	38	18	17	9	9
1984	129	46	36	53	41	21	16	9	7

Source: Characteristics of New Housing, Construction Reports, Series C25,
Bureau of the Census, various issues.

TABLE 3.9 Space Heating Fuels Used in New Single Family Homes,
Northeast Region, 1966 - 1984
(Thousands of Units)

FIGURE 3.6 Space Heating Fuels Used in Single Family Homes, Northeast Region, 1966 - 1984

Remarks:

1. As with existing housing, the use of fuel oil for space heating is most prevalent in the Northeast. Fuel oil use in new homes has decreased sharply however, going from 49% of all new homes in 1977 to 13% of all new homes in 1981. Since 1981 there has been only a slight increase in oil usage.
2. In 1966, electricity was in a distant third place behind gas and oil as a space heating fuel for new single family homes in the Northeast. Its popularity grew rapidly, however, and in 1974 it surpassed both gas and oil to become the most popular fuel. Since that time its share has remained relatively stable at around 35% of all new homes.
3. The popularity of natural gas suffered a precipitous decline from 1967 through 1976, falling from 56% to 18%. The popularity of gas increased sharply after 1978, however, and has continued to increase since then. By 1982 natural gas was once again the most common space heating fuel used in new single family houses, holding a slim edge over electricity.

Space Heating Fuels Used in New Single Family Homes in the North Central Region

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1966	77	5	7	63	83	7	10	1	1
1967	178	15	9	141	80	19	11	2	1
1968	197	16	8	155	78	25	13	1	1
1969	154	15	10	129	83	10	6	1	1
1970	161	21	13	128	80	11	7	1	1
1971	207	26	13	160	78	19	9	2	1
1972	235	37	16	173	74	21	9	2	1
1973	262	66	25	160	61	34	13	(B)	(B)
1974	220	79	36	112	51	26	12	3	1
1975	218	83	38	107	49	20	9	8	4
1976	271	109	40	130	48	26	10	6	2
1977	300	121	40	138	46	30	10	11	4
1978	300	107	36	149	50	32	11	11	4
1979	294	96	33	162	55	22	7	14	5
1980	170	46	27	101	60	6	4	16	10
1981	140	37	26	87	62	(B)	(B)	13	10
1982	92	24	26	53	57	3	3	13	14
1983	142	35	25	92	65	(B)	(B)	13	9
1984	156	30	19	110	71	(B)	(B)	14	9

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Series C25,
Bureau of the Census, various issues.

TABLE 3.10 Space Heating Fuels Used in Single Family Homes
North Central Region, 1966 - 1984
(Numbers in Thousands)

FIGURE 3.7 Space Heating Fuels Used in New Single Family Homes
North Central Region, 1966 - 1984

Remarks:

1. In the North Central region the incidence of electricity as a space heating fuel in single family houses increased dramatically between 1966 and 1977, going from a 7% of all new single family homes to 40%. This increase was mirrored by the decline in the incidence of natural gas. Since 1977, the popularity of electricity has declined substantially, falling to a 19% share in 1984.
2. Natural gas has been the most popular fuel for new single family homes throughout the period of 1966 through 1984. It suffered a precipitous decline in popularity through 1977. This trend reversed however and the incidence of gas has increased from a low of 46% in 1977 to 71% in 1984.
3. Since 1978, the use of fuel oil as a space heating fuel in new single family homes has declined to the point of insignificance in the North Central Region. Prior to that year fuel oil had been used in about 10% of new single family houses. Its use has declined to the point that there is insufficient data available to accurately estimate its incidence.

Space Heating Fuels Used in New Single Family Homes in the Southern Region

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1966	140	39	28	78	56	16	11	7	5
1967	329	95	29	189	58	31	9	13	4
1968	332	105	32	191	57	25	7	12	4
1969	316	110	35	178	57	21	7	6	2
1970	341	133	39	183	54	17	5	7	2
1971	450	202	45	220	49	19	4	8	2
1972	533	277	52	223	42	21	4	10	2
1973	526	312	59	172	33	35	7	7	1
1974	397	266	67	109	27	16	4	5	1
1975	362	239	66	105	29	14	4	4	1
1976	410	260	63	120	29	22	5	8	2
1977	512	341	67	139	27	23	4	8	2
1978	571	392	69	153	27	16	3	9	2
1979	535	365	68	147	28	14	3	9	2
1980	455	303	67	136	30	5	1	11	2
1981	408	262	64	128	31	(8)	(B)	16	4
1982	340	214	63	112	33	(B)	(B)	13	4
1983	476	296	62	163	34	(B)	(B)	15	3
1984	508	325	64	170	33	(8)	(B)	12	2

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Series C25,
Bureau of the Census, various issues.

TABLE 3.11 Space Heating Fuels Used in New Single Family Homes
Southern Region, 1966 - 1984
(Thousands of Units)

FIGURE 3.8 Space Heating Fuels Used in New Single Family Homes
Southern Region, 1966 - 1984

Remarks:

1. Natural gas was the predominant space heating fuel in the South during the mid-1960's. However, by 1972 electricity surpassed gas as the most popular fuel. Since then electricity has been the space heating fuel of choice in over 60% of all new units. Gas in the mean time has declined to around 33%
2. Fuel oil has essentially disappeared as a space heating fuel in new single family houses in the South, going from a high of 11% in 1966 to a low of 1% or less by 1980.

Space Heating Fuels Used in New Single Family Homes in the Western Region

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1966	53	12	24	40	73	1	2	2	1
1967	147	28	20	113	76	4	3	1	1
1968	149	34	23	111	74	3	2	1	1
1969	140	35	25	101	72	3	2	1	1
1970	148	33	22	113	76	1	1	1	1
1971	217	46	21	167	77	2	1	2	1
1972	242	63	26	174	72	2	1	2	1
1973	253	74	29	175	69	(B)	(B)	(B)	(B)
1974	191	63	33	126	66	(B)	(B)	(B)	(B)
1975	182	71	39	107	59	(B)	(B)	3	2
1976	232	91	39	139	60	(B)	(B)	(B)	(8)
1977	311	130	42	176	57	(B)	(B)	4	1
1978	357	162	45	186	52	(B)	(B)	9	2
1979	337	154	46	170	51	(B)	(B)	12	4
1980	233	97	42	121	52	(B)	(B)	14	6
1981	183	74	41	94	51	(B)	(B)	15	8
1982	121	50	41	59	49	(B)	(B)	12	10
1983	200	79	40	105	53	(B)	(B)	16	8
1984	233	91	39	127	55	(B)	(B)	14	6

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Series C25,
Bureau of the Census, various issues.

TABLE 3.12 Space Heating Fuels Used in New Single Family Homes
Western Region, 1966 - 1984
(Numbers in Thousands)

FIGURE 3.9 Space Heating Fuels Used in New Single Family Homes
Western Region, 1966 - 1984

Remarks:

1. Natural gas, which was the preponderant space heating fuel in the West during the late 1960's and early 1970's, is still the fuel used most often. However, electricity, which had lagged far behind, has seen a substantial increase in its share.
2. As in the other regions there has been a dramatic increase in the incidence of electricity as a space heating fuel in new single family houses.
3. The incidence of new single family homes with other or no space heating fuels was very low from 1966 through most of the 1970's. Starting in 1977, however, the incidence of such homes increases dramatically and from 1979 through 1984 there are 12,000 to 16,000 such houses built annually.

3.5 SPACE HEATING SYSTEMS IN NEW SINGLE FAMILY HOMES

Space Heating Systems in All New Single Family Homes

Year	Total Number of Houses	CENTRAL SYSTEMS						BUILT-IN SYSTEMS			
		Furnace		Electric Heat Pump		Hot Water or Steam		Electric		OTHER/NONE	
		#	%	#	%	#	%	#	%	#	%
1973	1,197	890	74			70	6	180	15	58	5
1974	904	686	72			54	6	164	18	36	4
1975	831	633	71			55	7	143	17	45	6
1976	994	788	75			59	6	147	15	40	4
1977	1,198	977	76			57	6	154	13	60	5
1978	1,314	781	59	336	26	65	5	132	10	56	4
1979	1,249	727	58	333	27	62	5	127	10	52	4
1980	957	541	57	233	24	36	4	86	9	62	6
1981	819	458	56	202	25	26	3	68	8	64	8
1982	632	334	58	166	29	24	4	50	9	58	10
1983	924	513	59	265	30	35	4	56	6	54	6
1984	1,025	565	58	309	32	42	4	60	6	50	5

Note: Electric Heat Pump classified under "Furnace" until 1978.

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.13 Heating System Types in New Single Family Homes
United States, 1973 - 1984
(Thousands of Units)

FIGURE 3.10 Space Heating Systems Used in New Single Family Homes
United States, 1973 - 1984

Remarks:

1. Prior to 1978 heat pumps were classified under warm air ducted furnaces. It was during that time that heat pumps had their most dramatic increase in incidence. Since then, as is clear from Figure 3.11, the percentage share of heat pumps in new single family homes has increased much more slowly.
2. Ducted heating systems (warm air furnaces and heat pumps) have had a substantial increase incidence over the period shown, going from 75% in 1973 to 85% in 1983 and 1984. Other heating system types, and especially hot water or steam systems and built-in electric systems, have declined in incidence during this period. The incidence of heating systems categorized as "Other/None" increased substantially in 1981 and 1982 but has now returned to previous levels.

Space Heating Systems In New Single Family Homes in the Northeast Region

Year	Total Number of Houses	CENTRAL SYSTEMS						BUILT-IN SYSTEMS			
		Furnace		Electric Heat Pump		Hot Water or Steam		Electric		OTHER/NONE	
		#	%	#	%	#	%	#	%	#	%
1973	156	58	37			52	33	41	26	5	3
1974	132	46	35			39	29	44	33	3	2
1975	114	36	32			41	36	34	30	3	3
1976	121	41	34			46	38	31	26	3	2
1977	135	47	35			50	37	34	25	4	3
1978	141	39	28	12	8	46	33	34	24	10	7
1979	135	40	29	14	11	43	32	31	23	7	5
1980	100	34	34	11	11	23	23	24	24	8	8
1981	87	27	31	12	13	19	22	19	22	10	12
1982	79	25	32	10	13	20	26	16	20	8	11
1983	106	34	32	15	15	28	26	21	20	7	7
1984	129	42	32	21	16	36	28	23	18	7	5

Note: Electric Heat Pump classified under "Furnace" until 1978.

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.14 Space Heating Systems in New Single Family Homes
Northeast Region, 1973 - 1984
(Thousands of Units)

Remarks:

1. The Northeast exhibits the greatest regional diversity in heating system types. Although warm air ducted furnaces are the most prevalent heating system type, in 1984 they only account for 32% of all systems, a considerably lower incidence than in other regions. The incidence of hot water or steam systems and built-in electric systems is considerably higher in the Northeast than elsewhere (28% and 18%, respectively).
2. The use of heat pumps in new single family homes is increasing more rapidly in the Northeast than in other regions. As a result, ducted systems (warm air furnaces and heat pumps) have increased steadily over this period, going from 37% in 1973 to 48% in 1984.

Space Heating Systems in New Single Family Homes in the North Central Region

		CENTRAL SYSTEMS						BUILT-IN SYSTEMS			
		Furnace		Electric Heat Pump		Hot Water or Steam		Electric		OTHER/NONE	
Year	Total Number of Houses	#	%	#	%	#	%	#	%	#	%
1973	262	197	74			14	6	47	18	4	2
1974	220	156	70			13	6	45	20	6	3
1975	218	158	71			11	6	39	18	9	5
1976	270	203	74			11	4	51	19	7	3
1977	300	224	74			12	4	50	17	15	5
1978	300	196	65	53	18	14	5	29	10	7	2
1979	294	202	69	45	15	14	5	25	9	7	2
1980	170	117	69	21	12	9	5	14	8	9	5
1981	140	98	70	16	11	5	4	14	10	7	5
1982	92	61	66	7	7	3	3	12	13	10	10
1983	142	102	72	16	11	4	3	10	7	9	6
1984	155	122	78	12	8	4	3	10	6	7	5

Note: Electric Heat Pump classified under "Furnace" until 1978.

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census.

TABLE 3.15 Space Heating Systems in New Single Family Homes
North Central Region, 1973 - 1984
(Thousands of Units)

Remarks:

1. Warm air furnaces are by far the most common type of space heating equipment used in new single family homes in the North Central region, reaching 78% of all such houses in 1984.
2. Heat pumps were first classified separately in 1978, when 18% of the new single family homes in the region had then installed. Since that time the incidence of heat pumps has fallen substantially, reaching only 8% in 1984.
3. The incidence of hot water and/or steam systems and built-in electric systems has fallen considerably. Built-in electric systems have declined from 21% of all new single family homes in 1967 to 6% in 1984. The hot water and/or steam systems have fallen from 6% to 3% during that same period.

Space Heating Systems in New Single Family Homes in the Southern Region

		CENTRAL SYSTEMS						BUILT-IN SYSTEMS			
		Furnace		Electric Heat Pump		Hot Water or Steam		Electric		OTHER/NONE	
Year	Total Number of Houses	#	%	#	%	#	%	#	%	#	%
1973	526	416	78			3	1	68	13	39	8
1974	397	326	82			(B)	(B)	48	12	20	5
1975	362	296	81			(B)	(B)	40	11	25	7
1976	410	353	86			(B)	(B)	30	7	25	6
1977	512	447	87			(B)	(B)	29	6	33	7
1978	571	302	53	209	37	3	(Z)	29	5	28	5
1979	533	275	51	206	38	(B)	(B)	29	5	23	4
1980	453	244	54	154	34	(B)	(B)	25	6	30	7
1981	408	220	54	133	33	(B)	(B)	22	5	32	8
1982	339	183	54	116	34	(B)	(B)	14	4	26	8
1983	475	259	55	179	38	(B)	(B)	15	3	22	5
1984	507	260	51	214	42	(B)	(B)	13	3	20	4

Notes: Electric Heat Pump classified under "Furnace" until 1978.

B = Insufficient sample size.

Z = less than 0.5 percent.

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.16 Space Heating Systems in New Single Family Homes
Southern Region, 1973 - 1984
(Thousands of Units)

Remarks:

1. In 1983 and 1984 warm air furnaces and heat pumps accounted for at least 92% of all heating systems in new single family houses in the South. This represents a strong increase in usage over the period considered, rising from 78% in 1973.
2. 42% of all new single family homes in the South in 1984 were equipped with heat pumps. The consistently high percentage of Southern homes using heat pumps is well above the averages of other regions. Heat pumps appear to be experiencing only small increases in incidence of use at the present time, however.
3. The incidence of built-in electric systems has declined precipitously, falling from 68,000 units and a 14% share of the market in 1973 to 13,000 units and a 3% share of the market in 1984.

Space Heating Systems in New Single Family Homes in the Western Region

		CENTRAL SYSTEMS						BUILT-IN SYSTEMS			
Year	Total Number of Houses	Furnace		Electric Heat Pump		Hot Water or Steam		Electric		OTHER/NONE	
		#	%	#	%	#	%	#	%	#	%
1973	253	218	86			(B)	(B)	25	10	10	4
1974	191	157	82			(B)	(B)	26	14	8	4
1975	182	142	78			(B)	(B)	29	16	9	5
1976	232	190	82			(B)	(B)	35	15	5	3
1977	308	258	84			3	1	41	13	9	3
1978	357	242	68	62	17	3	1	39	11	12	3
1979	334	211	62	67	20	3	1	42	13	14	4
1980	230	147	64	46	20	(B)	(B)	22	10	15	7
1981	182	112	62	42	23	(B)	(B)	13	7	15	8
1982	120	65	54	32	27	(B)	(B)	9	8	14	11
1983	198	117	58	55	27	(B)	(B)	10	5	16	8
1984	232	141	60	62	26	(B)	(B)	13	6	16	7

Note: Electric Heat Pump classified under "Furnace" until 1978.
B = Insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census.

TABLE 3.17 Space Heating Systems in New Single Family Homes
Western Region, 1973 - 1984
(Thousands of Units)

Remarks:

1. In 1983 and 1984 warm air furnaces and heat pumps accounted for at least 86% of all heating systems in new single family houses in the West, the same percentage which they had in 1973. Built-in electric systems account for the bulk of the other systems (6%). Hot water and steam systems are essentially nonexistent.
2. Heat pumps, while not as popular in the West as in the South, are increasing faster in popularity in the West, rising from 17% in 1978 to 26% in 1984.
3. The incidence of built-in electric systems has declined sharply, falling from 42,000 units and a 13% share of the market in 1979 to 13,000 units and a 6% share of the market in 1984.

3.6 CENTRAL AIR CONDITIONING EQUIPMENT IN NEW SINGLE FAMILY HOMES

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	1,197	582	49	616	51
1974	940	451	48	489	52
1975	875	403	46	473	54
1976	1,034	511	49	523	51
1977	1,258	679	54	579	46
1978	1,369	797	58	572	42
1979	1,301	784	60	517	40
1980	957	598	63	358	37
1981	819	530	65	289	35
1982	632	416	66	216	34
1983	924	642	70	282	30
1984	1,025	723	71	302	29

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.18 Central Air Conditioning in New Single Family Homes
United States, 1973 - 1984
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	156	22	14	134	86
1974	132	21	16	111	84
1975	114	15	13	99	87
1976	121	16	13	105	87
1977	135	23	17	112	83
1978	141	28	20	113	80
1979	135	35	26	100	74
1980	100	29	29	71	71
1981	87	25	29	62	71
1982	79	21	27	58	73
1983	106	35	33	72	67
1984	129	44	34	85	66

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.19 Central Air Conditioning in New Single Family Homes
Northeast Region, 1973 - 1984
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	262	92	35	170	65
1974	220	79	36	141	64
1975	218	77	35	141	65
1976	271	107	40	164	60
1977	300	132	44	169	56
1978	300	141	47	159	53
1979	294	137	47	157	53
1980	170	77	45	93	55
1981	140	67	48	73	52
1982	92	40	43	53	57
1983	142	70	50	70	50
1984	156	86	55	71	45

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.20 Central Air Conditioning in New Single Family Homes
North Central Region, 1973 - 1984
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	526	363	69	163	31
1974	397	286	72	111	28
1975	362	258	71	104	29
1976	410	320	78	90	22
1977	512	412	80	100	20
1978	571	480	84	90	16
1979	535	457	85	78	15
1980	455	384	84	71	16
1981	408	344	84	65	16
1982	340	290	85	50	15
1983	476	428	90	48	15
1984	508	466	92	42	10

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.21 Central Air Conditioning in New Single Family Homes
Southern Region, 1973 - 1984
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	253	104	41	149	59
1974	191	64	34	127	66
1975	182	53	29	129	71
1976	232	68	29	164	71
1977	311	112	36	199	64
1978	357	149	42	209	58
1979	337	155	46	182	54
1980	233	109	47	124	53
1981	183	94	51	90	49
1982	121	64	53	56	47
1983	200	109	55	91	45
1984	233	127	55	105	45

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 3.22 Central Air Conditioning in New Single Family Homes
Western Region, 1973 - 1984
(Thousands of Units)

FIGURE 3.11 Central Air Conditioning in New Single Family Homes
by Region, 1973 - 1984
(Thousands of Units)

Remarks:

1. Since 1975 there has been a steady increase in the percentage of single family dwelling being constructed with central air conditioning. In 1975, 46% of all new single family homes came with central air conditioning; by 1984, 71% had it, an increase of 54% over a 10-year period.
2. Single family construction has had some dramatic swings during the period of 1973 through 1984. The inclusion of central air conditioning in single family construction has not been subject to the same fluctuations, however. For instance, although new single family homes declined from 1,369,000 in 1978 to 632,000 in 1982 (see Table 3.1) the percentage of new homes with central air conditioning continued to increase during that period, going from 58% to 66%. Moreover, the regions with the greatest decline in construction -- the South and the West -- were relatively unaffected in terms of their central air conditioning penetration rates.
3. The South, which in recent years has had approximately one-half of all new single family construction in the country, also has the highest incidence of central air conditioning in new construction. This combination of factors has kept the average for the US as a whole well above the averages for the other 3 regions.
4. Central air conditioning requires the existence of ductwork. Although conclusive information is not available, the increased incidence of both central air conditioning and ducted furnaces may be related.

Since 1975 there has been a steady increase in the percentage of single-family dwellings built in the central and southern regions. In 1984, 45% of all new single-family homes were built in the central region, up from 41% in 1975, an increase of 10% over the 10-year period.

Single-family construction has had some dramatic swings during the period of 1975 through 1984. The number of central air conditioning in single-family construction was not a new subject in the same direction, however, for instance, although new single-family homes declined from 1,200,000 in 1975 to 1,000,000 in 1984 (see Table 3.1), the percentage of new homes with central air conditioning continued to increase during that period, going from 35% to 50%. Moreover, the region with the greatest decline in construction -- the South and the West -- were relatively unaffected in terms of their central air conditioning penetration rates.

The South, which in recent years has had significantly opposite of all new single-family construction in the country, also has the highest percentage of central air conditioning in new construction. This condition of factors has kept the average for the US as a whole well above the averages for the other 3 regions.

Central air conditioning requires the existence of a network. Although extensive information is not available, the increased incidence of central air conditioning and related factors may be related.

CHAPTER FOUR: CHARACTERISTICS OF NEW MULTI-FAMILY CONSTRUCTION IN THE U.S.

This chapter provides general information on energy-related characteristics of multi-family homes constructed in the U.S. between 1973 and 1984. Data for this chapter was taken primarily from various issues of Characteristics of New Housing, an annual publication of the Bureau of the Census. At the time that this edition of the Residential and Commercial Buildings Data Book was produced, information on new construction was available only through 1984.

This chapter is comprised of the following sections:

<u>Section Number</u>	<u>Section Title</u>	<u>Page Number</u>
4.1	A Comparison of New Multi-Family Building and Units	4.2
4.2	Regional Distribution of New Multi-Family Homes	4.4
4.3	Space Heating Fuels Used in New Multi-Family Buildings	4.6
4.4	Air Conditioning Equipment in New Multi-Family Buildings	4.12
4.5	Square Feet of Floor Space in New Multi-Family Units	4.16
4.6	Space Heating Fuels Used in New Multi-Family Units	4.20
4.7	Air Conditioning Equipment in New Multi-Family Units	4.26

4.1 A COMPARISON OF NEW MULTI-FAMILY BUILDINGS AND UNITS

Year	Total # of Buildings	2-4 Units		5-9 Units		10-19 Units		20-29 Units		30-49 Units		50 or More	
		#	%	#	%	#	%	#	%	#	%	#	%
1973	94	45	48	25	26	17	18	4	5	2	2	1	2
1974	78	34	44	22	28	14	18	4	5	2	3	2	2
1975	46	23	49	12	27	7	15	2	4	1	3	1	2
1976	48	30	62	9	20	6	12	2	3	1	2	(Z)	(8)
1977	58	35	61	12	20	8	13	2	3	1	1	(Z)	(8)
1978	73	44	60	15	22	9	13	4	3	1	1	1	1
1979	78	47	60	17	21	10	13	2	3	1	2	1	1
1980	74	43	59	17	23	10	13	2	2	1	2	1	1
1981	64	41	64	13	20	7	11	2	3	1	1	1	1
1982	47	28	60	10	21	6	13	2	4	1	2	1	1
1983	60	33	55	15	25	9	15	2	3	1	1	1	1
1984	75	38	49	19	26	14	18	4	5	1	2	1	1

Note: B = insufficient sample size.
Z = less than 0.5 percent

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.1 Number of Units Per Multi-Family Building, United States
(Thousands of Buildings)

FIGURE 4.1 Number of New Multi-Family Buildings, by Units per Building
(Thousands of Buildings)

FIGURE 4.2 Building Size As A Percentage of Total Buildings

Remarks:

1. For the period of 1973 through 1984, the majority of all multi-family units (55%) were found in the smallest class of building (2 - 4 units). The second smallest class of building (5 to 9 units) contained 22% of all new units for the same period.
2. When multi-family construction slumps, the decline is proportionately greater in new multi-family buildings with more than four units. Conversely, when multi-family construction picks up, the increase in these buildings is proportionately greater. Thus the curve for 2 to 4 unit buildings is an approximate mirror image of those of the other building classes.
3. By 1976 the smaller-sized buildings (those under 10 units per building) had captured an increased portion of the market, going from 72% to 82% of that market. Since 1976 this share has been quite stable, fluctuating between 80% and 85%. In the Northeast and the North Central regions these smaller multi-family buildings are continuing to increase their share and, although their share is decreasing in the South and West, the trends in the first two regions are strong enough to move the overall US share up in 1984.

4.2 REGIONAL DISTRIBUTION OF NEW MULTI-FAMILY BUILDINGS

# Bldg U.S.	# Bldgs N.E.	% of U.S.	# Bldgs N.C.	% of U.S.	# Bldgs SO.	% of U.S.	# Bldgs WEST	% of U.S.
94	14	14.9	17	18.1	38	40.4	25	26.6
78	9	11.5	16	20.5	32	41.0	19	24.4
46	6	13.0	11	23.9	15	32.6	13	28.3
48	6	12.5	12	25.0	13	27.1	16	33.3
58	6	10.3	13	22.4	16	27.6	23	39.7
73	6	8.2	17	23.3	24	32.9	26	35.6
78	6	7.7	16	20.5	29	37.2	27	34.6
74	5	6.8	14	18.9	31	41.9	22	29.7
64	5	7.8	11	17.2	32	50.0	16	25.0
47	4	8.5	7	14.9	25	53.2	11	23.4
60	4	6.7	8	13.3	34	56.7	14	23.3
75	5	6.7	9	12.0	43	57.3	19	25.3

Characteristics of New Housing. Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.2 Number of Multi-Family Buildings, by Census Region
(Thousands of Buildings)

FIGURE 4.3 Number of New Multi-Family Buildings, by Region

FIGURE 4.4 Regional Shares of Total New Multi-Family Buildings

Remarks:

1. Overall the trends in multi-family construction are very similar to those for single-family construction. For instance, construction slumps for both types of housing bottomed out in 1975 and 1982. There are some distinctions, however. For instance, after the slump of 1974-1975, new single family construction peaked in 1977. New multi-family construction peaked a year later, in 1978. The single family construction peak of 1977 was considerably higher than the 1973 level. In contrast, the multi-family construction peak of 1978 was very much below the 1973 level. However, the increase in multi-family growth after the 1982 slump has been proportionately much greater than the increase in single family construction.
2. Since 1979 the South has become the predominant region in the construction of multi-family buildings. For the 4 years prior to that, however, and in contrast to single family construction, the West and the North Central regions had similar levels of construction.
3. The Northeast, which has the highest percentage of existing multi-family units of any of the four regions, has the lowest level of new multi-family construction. It also has the least fluctuation in construction.

4.3 SPACE HEATING FUELS USED IN NEW MULTI-FAMILY BUILDINGS

Space Heating Fuel Usage in All New Multi-Family Buildings

Year	Total # of Buildings	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	94	B	B	B	B	B	B	B	B
1974	78	46	60	30	39	1	1	Z	B
1975	46	27	58	18	40	1	3	Z	B
1976	48	28	59	17	35	2	5	Z	B
1977	58	37	64	18	32	2	4	Z	B
1978	73	47	65	23	31	2	3	Z	B
1979	78	51	65	25	32	1	2	1	1
1980	74	46	63	27	36	Z	B	1	1
1981	64	40	63	23	36	Z	B	Z	B
1982	47	30	64	16	34	B	B	1	1
1983	60	41	68	19	31	B	B	Z	B
1984	76	53	70	22	30	B	Z	Z	Z

Notes: B = insufficient sample size.
Z = less than 0.5 percent

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.3 Space Heating Fuels Used in New Multi-Family Buildings in the U.S.

FIGURE 4.5 Space Heating Fuels Used in New Multi-Family Buildings in the U.S.

Remarks:

1. At the present time almost all new multi-family buildings use either natural gas or electricity for space heating. Fuel oil, which had a small but noticeable incidence during the 1970's, has essentially disappeared.
2. Electricity is the fuel most frequently chosen for space heating in new multifamily buildings for the entire period of 1973 through 1984. During that time electricity's lead over natural gas has almost doubled. In 1984 70% of the new multi-family buildings use electricity while 30% use gas.

Space Heating Fuel Usage in New Multi-Family Buildings, Northeast Region

Year	Total # of Buildings	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	14	B	B	B	B	B	B	B	B
1974	9	4	47	4	44	1	9	Z	B
1975	6	2	41	3	43	1	16	Z	B
1976	6	3	43	2	31	2	26	Z	B
1977	6	3	50	2	28	1	21	Z	B
1978	6	3	46	2	24	2	30	Z	B
1979	6	3	50	2	30	1	20	Z	B
1980	5	3	51	2	44	Z	B	Z	B
1981	5	2	35	3	56	Z	B	Z	B
1982	4	2	44	2	48	B	B	Z	B
1983	4	1	32	3	64	B	B	Z	B
1984	5	2	38	3	57	B	B	Z	B

Notes: B = insufficient sample size.
Z = less than 0.5 percent

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.4 Space heating Fuels Used in New Multi-Family Buildings, Northeast Region
(Thousands of Buildings)

Remarks:

1. The Northeast was the only region which had any significant use of fuel oil as a space heating fuel for new multi-family housing between 1973 and 1984. However, (and unlike the findings for single family housing) the use of fuel oil disappears in the Northeast after 1979.

Space Heating Fuel Usage in New Multi-Family Buildings, North Central Region

Year	Total # of Buildings	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	17	8	8	8	8	8	8	8	8
1974	16	7	45	9	54	Z	8	Z	8
1975	11	5	48	6	51	Z	8	Z	8
1976	12	7	53	5	44	Z	8	Z	8
1977	13	7	55	5	39	1	6	Z	8
1978	17	10	58	7	40	Z	8	Z	8
1979	16	8	51	8	48	Z	8	Z	8
1980	14	8	54	7	46	Z	8	Z	8
1981	11	4	39	7	61	Z	8	Z	8
1982	7	2	33	5	63	8	8	Z	3
1983	8	3	35	5	64	8	8	Z	8
1984	8	4	46	5	54	8	8	Z	8

Notes: B = insufficient sample size.
Z = less than 0.5 percent

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.5 Space Heating Fuels Used in New Multi-Family Buildings, North Central Region
(Thousands of Buildings)

Remarks:

1. The popularity of electricity as a space heating fuel in multi-family housing grew rapidly in the North Central region between 1974 and 1978, surpassing natural gas as the most popular fuel in the final year of that period. After 1978, however, its popularity diminished substantially, falling from 58% of all new multi-family buildings in 1978 to 46% in 1984.
2. Fuel oil and/or other fuels are used in only a very few new multi-family buildings in the North Central region.

Space Heating Fuel Usage in New Multi-Family Buildings, Southern Region

Year	Total # of Buildings	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	38	8	8	8	8	8	8	8	8
1974	32	25	78	7	22	Z	8	Z	8
1975	15	12	76	3	22	Z	8	Z	8
1976	13	10	76	3	21	Z	8	Z	8
1977	16	13	82	3	18	Z	8	Z	8
1978	24	21	88	3	12	Z	8	Z	8
1979	29	25	87	4	13	Z	8	Z	8
1980	31	25	80	6	20	Z	8	Z	8
1981	31	25	80	6	20	Z	8	Z	8
1982	26	21	82	5	18	8	8	Z	8
1983	34	29	85	5	14	8	8	Z	8
1984	43	37	86	6	13	8	8	Z	8

Notes: B = insufficient sample size.
Z = less than 0.5 percent

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.6 Space Heating Fuels Used in New Multi-Family Buildings, Southern Region
(Thousands of Buildings)

Remarks:

1. Electricity is by far the most commonly used space heating fuel in new multi-family buildings in the South. Natural gas comes in a distant second place. Fuel oil and other or no fuels are insignificant throughout the entire period. There is little indication that any of these situations are changing.
2. The fluctuations in the number of buildings which use natural gas is not as dramatic as the overall increases or decreases in multi-family construction.

Space Heating Fuel Usage in New Multi-Family Buildings, Western Region

Year	Total # of Buildings	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	25	8	8	8	8	8	8	8	8
1974	19	9	48	10	52	Z	8	Z	8
1975	13	7	51	6	49	Z	8	Z	8
1976	16	9	57	7	42	Z	8	Z	8
1977	23	14	60	9	39	Z	8	Z	8
1978	25	14	55	11	44	Z	8	Z	8
1979	27	15	54	12	44	Z	8	Z	8
1980	22	10	46	11	51	Z	8	Z	3
1981	16	9	54	7	44	Z	8	Z	8
1982	11	6	51	5	48	8	8	Z	8
1983	14	7	54	6	44	8	8	Z	8
1984	19	10	52	9	47	8	8	Z	8

Notes: B = insufficient sample size.
Z = less than 0.5 percent

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.7 Space Heating Fuels Used in New Multi-Family Buildings, Western Region
(Thousands of Buildings)

Remarks:

1. Electricity and natural gas are the only significant fuels used for space heating in new multi-family buildings in the West region. Although electricity is a bit more popular than natural gas, this popularity has diminished somewhat since the late 1970's.

4.4 AIR CONDITIONING EQUIPMENT IN NEW MULTI-FAMILY BUILDINGS

Year	Total # of Buildings	Installed		Not Installed	
		#	%	#	%
1973	94	8	8	8	8
1974	78	59	76	18	24
1975	46	34	74	12	26
1976	48	32	67	16	33
1977	58	40	69	18	31
1978	73	51	70	22	30
1979	78	59	76	19	24
1980	74	58	79	16	21
1981	64	50	78	14	22
1982	47	39	83	8	17
1983	60	51	85	9	15
1984	76	65	86	11	14

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.8 Air Conditioning in All New Multi-Family Buildings
(Thousands of Buildings)

Year	Total # of Buildings	Installed		Not Installed	
		#	%	#	%
1973	14		8		8
1974	9	6	62	3	38
1975	6	4	64	2	36
1976	6	4	65	2	35
1977	6	4	66	2	34
1978	6	3	47	3	53
1979	6	4	65	2	35
1980	5	3	57	2	43
1981	5	3	51	2	49
1982	4	2	52	2	48
1983	4	2	48	2	52
1984	5	3	50	3	50

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Report Series C25, Bureau of the Census, various issues.

TABLE 4.9 Air Conditioning in New Multi-Family Buildings
Northeast Region
(Thousands of Buildings)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	17		8	8	8
1974	16	13	79	3	21
1975	11	9	78	2	22
1976	12	10	78	3	22
1977	13	10	78	3	22
1978	17	13	76	4	24
1979	16	13	77	4	23
1980	14	12	81	3	19
1981	11	8	75	3	25
1982	7	5	73	2	27
1983	8	6	78	2	22
1984	8	7	85	1	15

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.10 Air Conditioning in New Multi-Family Buildings,
North Central Region
(Thousands of Buildings)

Year	Total # of Buildings	Installed		Not Installed	
		#	%	#	%
1973	38	8	8	8	8
1974	32	31	98	1	2
1975	15	15	96	1	4
1976	13	11	88	2	12
1977	16	16	96	1	4
1978	24	23	97	1	3
1979	29	28	96	1	4
1980	31	29	94	2	6
1981	32	29	93	2	7
1982	25	24	97	1	3
1983	34	33	97	1	3
1984	43	42	97	1	3

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports Series C25, Bureau of the Census, various issues.

TABLE 4.11 Air Conditioning Equipment in New Multi-Family Buildings,
Southern Region
(Thousands of Buildings)

Year	Total # of Buildings	Installed		Not Installed	
		#	%	#	%
1973	25		8		8
1974	19	9	47	10	53
1975	13	6	49	7	51
1976	16	7	43	9	57
1977	23	10	46	12	54
1978	26	12	48	14	52
1979	27	15	56	12	44
1980	22	14	62	8	38
1981	16	10	61	6	39
1982	10	8	70	3	30
1983	14	10	71	4	29
1984	19	14	70	6	30

Note: 8 = insufficient sample size.

Source: Characteristics of New Housing, Construction Report Series C25, Bureau of the Census, various issues.

TABLE 4.12 Air Conditioning Equipment in New Multi-Family Buildings
Western Region
(Thousands of Buildings)

FIGURE 4.6 Air Conditioning in New Multi-Family Buildings, By Region

Remarks:

1. The patterns exhibited by the figures for incidence of air conditioning in multi-family units are repeated with only minor variations by the figures for incidence of AC in multi-family buildings.
2. For the period in question the percentage of new multifamily units with air conditioning is consistently higher than the percentage of new multi-family buildings with air conditioning. If the existence of air conditioning is uniform for all units of any given building, then the higher units percentage indicates that units in larger multi-family buildings (buildings with higher numbers of units) are more likely to have air conditioning installed at the time of construction than are units in smaller multi-family buildings.

4.5 AVERAGE SQUARE FEET OF FLOOR SPACE IN NEW MULTI-FAMILY UNITS

Year	Total # of Units	Less Than 600 Sq. Ft.		600 Sq. Ft. to 799 Sq. Ft.		800 Sq. Ft. to 999 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	903	114	13	211	23	266	29	175	19	138	15
1974	788	88	11	165	21	228	29	146	19	162	20
1975	442	44	10	93	21	119	27	80	18	106	24
1976	343	36	10	92	27	96	28	60	18	59	17
1977	399	52	13	99	25	124	31	61	15	62	16
1978	498	63	13	144	29	144	29	75	15	73	15
1979	570	61	11	146	26	165	29	102	18	96	17
1980	545	53	10	129	24	155	28	102	19	106	19
1981	447	40	9	94	21	138	31	84	19	92	21
1982	374	33	9	75	20	124	33	61	16	80	21
1983	467	50	11	117	25	147	31	78	17	75	16
1984	627	64	10	180	29	194	31	104	17	86	14

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.13 Average Square Footage in All New Multi-Family Units
(Thousands of Units)

Year	Total # of Units	Less Than 600 Sq. Ft.		600 Sq. Ft. to 799 Sq. Ft.		800 Sq. Ft. to 999 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	138	18	13	22	16	41	30	33	24	23	17
1974	99	11	11	17	17	31	31	22	22	19	19
1975	72	9	13	8	11	21	28	17	24	17	24
1976	50	5	9	6	12	14	28	13	26	13	26
1977	41	4	10	9	23	12	28	6	14	10	25
1978	41	3	6	17	42	9	22	6	14	7	17
1979	53	4	8	13	25	17	32	9	17	9	18
1980	46	4	8	14	31	12	26	7	15	9	20
1981	40	2	5	6	14	20	49	5	14	7	18
1982	41	5	13	6	14	17	42	5	13	8	18
1983	32	6	18	6	18	9	19	6	18	5	17
1984	40	5	13	10	26	10	24	6	15	9	22

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.14 Average Square Footage in New Multi-Family Units,
Northeast Region
(Thousands of Buildings)

Year	Total # of Units	Less Than 600 Sq. Ft.		600 Sq. Ft. to 799 Sq. Ft.		800 Sq. Ft. to 999 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	180	19	10	38	21	55	30	35	20	32	18
1974	157	24	15	31	20	50	32	28	18	24	15
1975	96	8	8	24	25	32	33	15	16	16	17
1976	84	7	8	25	30	26	31	16	19	9	11
1977	99	14	14	23	23	38	38	16	16	9	9
1978	117	16	14	31	27	37	31	18	15	15	13
1979	121	13	11	36	30	32	26	22	18	19	15
1980	104	12	12	19	19	33	31	24	24	15	14
1981	78	9	11	16	20	24	31	17	22	12	16
1982	51	4	8	8	17	19	38	10	19	9	18
1983	59	2	4	14	24	19	31	15	26	9	15
1984	65	4	6	19	29	19	29	13	20	11	16

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.15 Average Square Footage in New Multi-Family Units,
North Central Region
(Thousands of Units)

Year	Total # of Units	Less Than 600 Sq. Ft.		600 Sq. Ft. to 799 Sq. Ft.		800 Sq. Ft. to 999 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	380	50	13	82	22	107	28	79	21	63	16
1974	359	37	10	73	20	99	28	69	19	81	23
1975	170	14	8	36	21	39	23	33	20	48	28
1976	103	10	10	29	28	27	26	18	17	20	19
1977	125	14	11	30	24	39	31	21	16	21	17
1978	181	21	12	56	31	52	29	28	15	24	13
1979	227	23	10	55	24	67	30	43	19	38	17
1980	242	22	9	58	24	68	28	44	18	50	21
1981	218	17	8	52	24	63	29	40	18	46	21
1982	199	16	8	43	22	65	32	32	16	44	22
1983	270	27	10	70	26	86	32	40	15	47	18
1984	358	39	11	104	29	109	30	58	16	48	13

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.16 Average Square Footage of New Multi-Family Units,
Southern Region
(Thousands of Units)

Year	Total # of Units	Less Than 600 Sq. Ft.		600 Sq. Ft. to 799 Sq. Ft.		800 Sq. Ft. to 999 Sq. Ft.		1,000 Sq. Ft. to 1,199 Sq. Ft.		1,200 Sq. Ft. or more	
		#	%	#	%	#	%	#	%	#	%
1973	205	27	13	68	33	62	30	29	14	19	10
1974	173	16	9	43	25	49	28	28	16	37	22
1975	105	13	12	25	24	26	25	16	15	25	24
1976	106	13	13	32	30	29	27	14	14	18	17
1977	133	20	15	37	28	36	27	19	15	22	16
1978	160	23	14	40	25	47	29	24	15	27	17
1979	169	20	12	41	25	49	29	28	17	30	18
1980	153	15	10	38	25	42	28	27	17	32	21
1981	111	11	10	20	18	31	28	22	20	26	24
1982	82	8	10	17	21	23	28	14	17	20	24
1983	104	15	15	27	26	33	32	16	16	13	12
1984	164	16	10	46	28	57	34	26	16	19	11

Source: Characteristics of New Housing, Construction Reports, Series C25, Bureau of the Census, various issues.

TABLE 4.17 Average Square Footage of New Multi-Family Units,
Western Region
(Thousands of Buildings)

FIGURE 4.7 Number of New Multi-Family Units, by Square Footage Category
(Thousands of Units)

FIGURE 4.8 Units per Size Category as a Percentage of Total Units

Remarks:

1. The size of new multi-family units constructed in the US between 1973 and 1984 exhibited considerable variation. Units of 800-999 square feet were always the largest type of unit constructed, generally having a share of 29% or more. Units of 600-799 square feet were the next most prevalent type when averaged over the period, ranging from 20-29%.
2. The percentage of the largest size category, 1,200 square feet or more, varied inversely with the increases and decreases in overall multifamily construction, suggesting that, during declines in construction, this type of unit is significantly less affected than the other types.

4.6 SPACE HEATING FUELS USED IN NEW MULTI-FAMILY UNITS

Space Heating Fuels Used In All New Multi-Family Units

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	903	B	B	B	B	B	B	B	B
1974	788	472	60	279	35	30	4	7	1
1975	442	260	59	145	33	30	7	7	2
1976	343	202	59	113	33	24	7	3	1
1977	399	261	66	115	29	18	5	4	1
1978	498	339	68	131	26	24	5	5	1
1979	570	386	68	150	26	27	5	6	1
1980	545	362	66	165	30	12	2	6	1
1981	447	293	66	142	32	7	2	4	1
1982	374	255	68	103	28	9	3	7	2
1983	467	327	70	133	28	3	1	4	1
1984	627	452	72	165	26	5	1	5	1

Notes: B = insufficient sample size.
Z = less than 0.5 percent.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.18 Space Heating Fuels Used in All New Multi-Family Units
United States
(Thousands of Units)

FIGURE 4.9 Space Heating Fuel Use in New Multi-Family Units

Remarks:

1. Not surprisingly, the use of various fuel types in multi-family units closely parallels fuel usage in multi-family buildings. For instance, electricity and natural gas are the two most popular fuels. There are some differences, however.
2. With regard to space heating fuel types, the major difference which can be discerned between multi-family units and buildings involves the percentage share which each fuel has of the total. For instance, the percentage of units which use electricity for space heating is consistently above the percentage of buildings which do so. This indicates that electricity tends to be used in buildings with a relatively higher number of units. Just the opposite is true of natural gas, where the percentage of units is consistently lower than the percentage of buildings.
3. Multi-family buildings with oil heat disappear from the tables after 1979. When looking at multi-family units, however, there are still discernable numbers. This suggests that, like electricity, fuel oil tends to be used more frequently in buildings with relatively higher numbers of units.

Space Heating Fuels Used In New Multi-Family Units, Northeast Region

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	138	B	B	B	B	B	B	B	B
1974	99	44	44	28	28	22	22	6	6
1975	72	25	35	17	24	24	34	6	8
1976	50	21	42	11	22	16	32	2	4
1977	41	20	48	9	22	10	24	2	6
1978	41	13	33	9	23	18	44	Z	B
1979	53	21	39	11	20	21	40	Z	B
1980	46	20	43	16	34	10	22	Z	B
1981	40	11	28	23	58	5	14	Z	B
1982	41	17	40	15	37	8	20	1	3
1983	33	9	29	21	63	B	B	Z	B
1984	40	18	49	16	51	B	B	1	B

Notes: B = insufficient sample size.
Z = less than 0.5 percent.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.19 Space Heating Fuels Used In New Multi-Family Units,
Northeast Region
(Thousands of Units)

Remarks:

1. Until 1984 the percentage of multi-family units which used electricity for space heating in the Northeast was consistently below the percentage of multi-family buildings which did. This indicates that electricity was used more frequently as a space heating fuel in buildings with relatively fewer units. In 1984, however, the percentage of units which used electricity (49%) was considerably above the percentage of buildings which did (38%).
2. As with electricity, the percentage of new multi-family units in the Northeast which used natural gas for space heating was consistently below the percentage for multi-family buildings. Only in 1981 did the units' percentage (58%) exceed the buildings' percentage (56%).

Space Heating Fuels Used In New Multi-Family Units, North Central Region

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	180	B	B	B	B	B	B	B	B
1974	157	62	39	93	59	1	1	1	1
1975	96	47	49	48	50	Z	B	1	1
1976	84	44	52	39	46	1	2	Z	B
1977	99	54	55	39	39	6	6	Z	B
1978	117	70	60	44	38	2	2	Z	B
1979	121	69	57	50	41	2	1	1	1
1980	104	57	55	46	45	Z	B	1	1
1981	78	36	46	42	54	Z	B	Z	B
1982	51	17	33	32	63	B	Z	2	3
1983	59	22	37	37	62	B	B	1	1
1984	65	32	49	34	51	B	B	Z	B

Notes: B = insufficient sample size.
Z = less than 0.5 percent.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.20 Space Heating Fuels Used in New Multi-Family Units,
North Central Region
(Thousands of Units)

Remarks:

1. The percentage of new multi-family units in the North Central region which use electricity for space heating tends to be lower than the percentage of multi-family buildings which do. This indicates that electricity is used more frequently in buildings with relatively fewer units.

Space Heating Fuels Used in New Multi-Family Units, Southern Region

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	380	B	B	B	B	B	B	B	B
1974	359	275	76	76	21	7	2	Z	B
1975	170	133	78	31	18	5	3	Z	B
1976	103	78	76	19	18	6	6	1	1
1977	125	106	85	16	13	3	2	Z	B
1978	181	161	89	16	9	3	2	1	1
1979	227	200	88	22	10	4	2	2	1
1980	242	203	84	36	15	2	1	Z	B
1981	218	184	84	33	15	1	1	Z	B
1982	199	176	88	21	11	B	B	1	2
1983	270	238	88	31	12	B	B	1	Z
1984	358	312	87	46	13	B	B	Z	B

Notes: B = insufficient sample size.
Z = less than 0.5 percent.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.21 Space Heating Fuels Used in New Multi-Family Units,
Southern Region
(Thousands of Units)

Remarks:

1. The percentage of new multi-family units in the South which use natural gas tends to be lower than the percentage of new multi-family buildings which do. This indicates that natural gas is used more frequently in buildings with relatively fewer units.

Space Heating Fuels Used In New Multi-Family Units, Western Region

Year	Total Number of Units	Electricity		Gas		Oil		Other or None	
		#	%	#	%	#	%	#	%
1973	205	B	B	B	B	B	B	B	B
1974	173	91	53	81	47	B	Z	Z	B
1975	105	56	53	48	46	B	Z	Z	B
1976	106	60	57	45	42	B	Z	Z	B
1977	133	81	61	51	38	B	1	1	1
1978	160	95	59	61	38	B	B	4	2
1979	169	97	58	68	40	B	B	4	2
1980	153	81	53	67	44	B	B	5	3
1981	111	63	56	44	40	B	B	4	4
1982	82	45	55	34	42	B	B	3	4
1983	104	58	55	44	42	B	B	3	2
1984	164	90	55	70	43	B	B	4	2

Notes: B = insufficient sample size.
Z = less than 0.5 percent.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.22 Space Heating Fuels Used in New Multi-Family Units,
Western Region
(Thousands of Units)

Remarks:

1. The percentage of new multi-family units in the West which use natural gas for space heating is lower than the percentage of new multi-family buildings which do. This indicates that natural gas is more frequently used as a space heating fuel in buildings with relatively fewer units.

4.7 AIR CONDITIONING IN NEW MULTI-FAMILY UNITS

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	903	8	8	8	8
1974	788	677	86	111	14
1975	442	377	85	65	15
1976	343	259	75	84	25
1977	399	318	80	81	20
1978	498	392	79	107	21
1979	570	475	83	95	17
1980	545	460	84	85	16
1981	447	383	86	65	14
1982	374	327	87	47	13
1983	467	414	89	53	11
1984	627	561	89	66	11

Note: 8 = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.23 Air Conditioning in All New Multi-Family Units
United States
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	138	8	8	8	8
1974	99	83	84	16	16
1975	72	64	89	8	11
1976	50	39	78	11	22
1977	41	35	84	7	16
1978	41	22	55	18	45
1979	53	43	81	10	19
1980	46	35	77	11	23
1981	40	32	79	8	21
1982	41	29	69	13	31
1983	33	20	60	13	40
1984	39	26	65	14	35

Note: 8 = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.24 Air Conditioning in New Multi-Family Units,
Northeast Region
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	180	8	8	8	8
1974	157	138	88	19	12
1975	96	84	88	12	12
1976	84	71	85	13	15
1977	99	86	86	14	14
1978	117	98	84	19	16
1979	121	98	81	23	19
1980	104	89	85	15	15
1981	78	64	83	14	17
1982	51	41	80	10	20
1983	59	48	81	11	19
1984	65	59	90	7	10

Note: 8 = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.25 Air Conditioning in New Multi-Family Units,
North Central Region
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	380	8	8	8	8
1974	359	352	98	7	2
1975	170	168	99	2	1
1976	103	96	93	7	7
1977	125	122	98	2	2
1978	181	178	98	3	2
1979	227	224	99	3	1
1980	242	231	96	11	4
1981	218	211	97	7	3
1982	199	195	98	4	2
1983	270	266	99	4	1
1984	358	353	99	5	1

Note: 8 = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.26 Air Conditioning in New Multi-Family Units,
Southern Region
(Thousands of Units)

Year	Total Number of Units	Installed		Not Installed	
		#	%	#	%
1973	205	8	8	8	8
1974	173	104	60	69	40
1975	105	62	59	43	41
1976	106	54	51	52	49
1977	133	75	56	58	44
1978	160	93	58	67	42
1979	169	110	65	59	35
1980	153	105	68	48	32
1981	111	75	68	36	32
1982	82	62	75	20	25
1983	104	80	76	25	24
1984	164	123	75	41	25

Note: B = insufficient sample size.

Source: Characteristics of New Housing, Construction Reports, Bureau of the Census, Series C25, various issues.

TABLE 4.27 Air Conditioning in New Multi-Family Units, Western Region (Thousands of Units)

FIGURE 4.10 Air Conditioning in New Multi-Family Units, by Region

Remarks:

1. All regions in the country experienced a large drop in the incidence of air conditioning in multi-family housing between 1975 and 1976. Overall the incidence of central air conditioning dropped by 10%. Since then, however, air condition has returned to its 1974 level.
2. The South, which has the highest incidence of air conditioning among the various regions, declined the least during 1975 and 1976, falling from 99% to 93%. After 1976 air conditioning incidence in the South again rose and then stayed very stable through 1984.
3. The North East, which in 1974 and 1975 showed an incidence of 84% and 89%, respectively, has demonstrated a long-term decline.
4. The West is the only region exhibiting significant long-term growth in air conditioning multi-family housing, increasing from 60% in 1975 to 70% in 1984. However, since 1982 the incidence of AC in the West has remained relatively constant, suggesting that this period of growth may be over.
5. The North Central region, after a gradual decline from 88% to 80%, has suddenly registered a dramatic increase, going from 81% in 1983 to 90% in 1984. This suggests that the region may be returning to its previous levels of incidence.

All regions in the country experienced a large drop in the incidence of air conditioning in multi-family housing between 1975 and 1978. Overall, the incidence of central air conditioning dropped by 10.7%. Since then, however, air conditioning has returned to its 1974 level.

The South, which has the highest incidence of air conditioning among the various regions, declined the least during 1975 and 1978, falling from 92% to 91%. After 1978 air conditioning incidence in the South again rose and then stayed very stable through 1984.

The North East, which in 1974 and 1975 showed an incidence of 84% and 83%, respectively, has demonstrated a long-term decline.

The West is the only region exhibiting significant long-term growth in air conditioning multi-family housing, increasing from 60% in 1975 to 70% in 1984. However, since 1982 the incidence of AC in the West has remained relatively constant, suggesting that this period of growth may be over.

The North Central region, which had a gradual decline from 62% to 60% in 1975, suddenly registered a dramatic increase, going from 61% in 1983 to 80% in 1984. This suggests that the region may be returning to its previous levels of incidence.

CHAPTER FIVE: HOUSEHOLD APPLIANCES

This chapter provides information on the possession and energy efficiency of various household appliances, including heating and cooling equipment. Data for this chapter was taken primarily from the Annual Energy Review, a publication of the Energy Information Administration, Facts on Major Home Appliance Energy Consumption and Efficiency Trends, a publication of the Association of Home Appliance Manufacturers, and The Behavior of Energy Efficiency in the Purchase of Appliances and Home Heating and Cooling Equipment, a publication of Lawrence Berkeley Laboratory. At the time that this edition of the Residential and Commercial Buildings Data Book was produced this was the most current information available.

This chapter is comprised of the following sections:

<u>Section Number</u>	<u>Section Title</u>	<u>Page Number</u>
5.1	Household Appliance Saturation Levels: 1978 & 1982	5.2
5.2	Builder-Installed Appliances in New Housing	5.3
5.3	Trends in Household Appliance Energy Efficiency and Energy Consumption	5.4
5.4	Shipment Weighted Energy Factors for Major Household Appliances	5.6

5.1 HOUSEHOLD APPLIANCE SATURATION LEVELS: 1978 and 1984

Appliance	1978	1984	1978	1984
Total Households.....	76.6	86.3	100	100
Type Appliances				
Electric Appliances				
Television Set (Color)....	N/A	75.9	N/A	88
Television Set (B/W).....	N/A	37.3	N/A	43
Clothes Washer.....	57.4	63.8	75	74
Range (Stove-Top or Burners).....	40.7	46.5	53	60
Oven.....	41.5	54.2	54	63
Microwave.....	6.0	29.6	8	34
Clothes Dryer.....	34.5	39.6	45	46
Separate Freezer.....	27.0	31.7	35	37
Dishwasher.....	26.5	32.5	35	38
Gas Appliances				
Range (Stove-Top or Burners).....	36.9	39.0	48	45
Oven.....	35.9	35.9	47	42
Clothes Dyer.....	11.0	13.7	14	16
Refrigerators				
One.....	66.0	75.8	86	88
Two or more.....	10.4	10.3	14	12
Air Conditioning (A/C)				
Central.....	17.6	25.7	23	30
Individual Room Units.....	25.1	25.8	33	30
None.....	33.8	34.9	44	40

Source: Annual Energy Review, U.S. DOE/EIA, April 1985.

TABLE 5.1 Household Appliance Saturation Levels, 1978 and 1982

Remarks:

1. The most notable changes between 1978 and 1982 are the increase in the percentage of homes which have central air conditioning and the increase in the possession of microwave ovens. Other noticeable changes include the slight decline in the possession of clothes washers and the trend towards electric ovens and away from gas ovens.

5.2 BUILDER-INSTALLED APPLIANCES IN NEW HOUSING

New Private Housing Completions in 1979: 1,870,800 (1)

Type of Appliance	% of Total New Housing Units (2)	% of Appliances Installed in New Homes (3) (Thousands)	Total # of Appliances Sold in 1979 (4) (Thousands)	Builder-Installed Appliances as a % of Total (5)
Refrigerators....	35.60	665.70	5301.80	12.60
Freezers.....			1773.60	0.00
Room Air Conditioners...	2.80	51.60	2830.40	1.80
Dryers.....	7.70	144.50	3475.00	4.20
Elec. Ranges & Ovens.....	67.90	1270.70	2977.20	42.70
Microwave Ovens.....	0.10	2.60	2447.00	0.10
Dishwashers.....	72.20	1350.20	3388.20	39.90
Washers.....	7.00	131.50	4601.00	2.90

Source: Association of Home Appliance Manufacturers, Facts on Major Home Appliance Energy Consumption and Efficiency Trends, January 1985.

- Notes: 1) As published in April, 1982 Economic Indicators prepared by the Council of Economic Advisors.
- 2) 1979 Housing Industry Dynamics Survey of Builder Installation Practices, approximately 4,500 responses.
- 3) Calculated using the percentages in column 1 and the figure for new private housing completions in 1979.
- 4) Association of Home Appliance Manufacturers reports of 1979 total industry distributor sales.
- 5) Data in column 2 divided by data in column 3.

TABLE 5.2 Builder-Installed Appliances in New Housing, 1979

Remarks

1. Of the appliances listed in Table 5.2, builders are most likely to install dishwashers in new housing units (72% of the new units had them installed). The next most frequently installed appliance type was electric ranges and ovens (68%). There is no data on gas ranges and ovens which, presumably, are installed in most of the remaining 32% of all new units.
2. Builder purchases of electric ranges and ovens and dishwashers constitute 43% and 40%, respectively, of all sales for these types of appliances. Builders are therefore a very important part of the market for these appliances.

5.3 TRENDS IN HOUSEHOLD APPLIANCE ENERGY EFFICIENCY AND ENERGY CONSUMPTION

	Adjusted Volume Per Unit (cu. ft.)	% Change in Volume Since 1972	Energy Consumption Per Unit (kwh/Yr.)	% Change In Consumption Since 1972	Efficiency (Energy Factor, EER)	% Change In Efficiency Since 1972	Capacity Per Unit (BTUs/Hr.)	% Change In Capacity Since 1972
Refrigerators								
1972	18.16		1,726.45		3.84	0.00		
1978	19.73	8.6	1,425.70	(15.90)	4.96	29.00		
1980	19.61	7.9	1,277.50	(26.00)	5.59	45.60		
1981	19.86	9.4	1,189.54	(31.10)	6.09	58.60		
1982	19.97	10	1,190.70	(31.00)	6.12	59.40		
1983	20.31	11.8	1,160.21	(32.80)	6.39	66.40		
Freezers								
1972	29.18		1,460.00		7.29	0.00		
1978	26.84	(8.00)	985.50	(32.50)	9.92	36.10		
1980	26.26	(10.00)	883.30	(39.50)	10.85	48.80		
1981	25.53	(12.50)	837.14	(42.70)	11.13	52.70		
1982	25.11	(13.90)	812.85	(44.30)	11.28	54.70		
1983	25.28	(13.40)	813.33	(44.30)	11.34	55.60		
Dishwashers								
1972			4.17*			0.00		
1979			3.23*	22.50	0.24	29.20		
1982			2.87*	31.20	0.31	45.80		
1983			2.70*	35.30	0.35	54.20		
Clothes Washers								
1972	2.44		3.81*		0.64	0.00		
1979	2.56	4.9	2.80*	(26.50)	0.91	42.20		
1981	2.52	3.3	2.59*	(32.00)	0.97	51.60		
1983	2.54	4.1	2.57*	(32.50)	0.99	54.70		
Room Air Conditioners								
1972			1,281.80		5.98**	0.00	10,226.80	
1978			1,209.20	(5.70)	6.72**	12.20	10,827.60	5.9
1980			1,134.20	(11.50)	7.02**	17.30	10,606.60	3.7
1981			1,161.10	(9.40)	7.06**	18.10	10,924.40	6.8
1982			1,135.00	(11.50)	7.14**	19.40	10,801.40	5.6
1983			1,087.80	(15.10)	7.29**	21.90	10,566.30	3.3

Source: Association of Home Appliance Manufacturers, Facts on Major Home Appliance Energy Consumption and Efficiency Trends, January 1985.

Note: * = kwh/cycle.
** = EER, energy efficiency ratio.

TABLE 5.3 Shipment Weighted Energy Factors for Household Appliances

FIGURE 5.1 Percentage Increase in the Efficiency of Major Appliances

Remarks:

1. The Energy Factor (EF) for a consumer appliance is the ratio of useful output of services to the amount of energy consumed by operating the appliance and is used as an expression of that appliance's energy efficiency. The efficiency of room air conditioners is expressed using an Energy Efficiency Ratio (EER).
2. The EF for refrigerators and freezers is the ratio of cubic feet of useful interior space to kilowatthour consumption per day.
3. The EF for dishwashers is the ratio of wash cycles per kilowatthour required for the normal dishwasher's cycle. Included in the kilowatthour number is the energy needed to heat the water.
4. The EF for clothes washers is the ratio of cubic feet of volume in the wash basket per kilowatthour required for a wash cycle. Here again the energy required to heat the water is included in the kWh number.
5. The EER for room air conditioners is the ratio of BTUs per hour per watt of electricity required, i.e., the cooling capacity of the unit (BTUs per hour) divided by the energy consumed by the unit (watts).
6. Since 1972 the efficiencies of all the appliances considered in Table 5.3 have increased substantially. Refrigerators have improved the most, achieving a 66% increase in efficiency. Room air conditioners have improved the least with a 22% gain in efficiency.
7. According to the Association of Home Appliance Manufacturers (AHAM), some reasons for the improvements in efficiency are:
 - o Refrigerators and Freezers -- improved insulation, door gaskets, compressors, and evaporator and condensor heat transfer systems.
 - o Dishwashers -- reduced hot water usage due to improvements in water circulation, reduced inflow rate of hot water, and the use of built-in water-heating elements.
 - o Clothes Washer -- fewer warm rinse options, multiple water level settings, and better water extraction for more efficient drying.
 - o Room Air Conditioners -- improved compressors, air circulation, and evaporator and condensor heat transfer systems.

5.4 SHIPMENT WEIGHTED ENERGY FACTORS FOR MAJOR HOUSEHOLD APPLIANCES

Appliance	Source	1972	1975	1976	1977	1978	1979	1980	1981	1982
Gas Central Space Heater (AFUE %)	CS-179	62.7	N/A	N/A	N/A	63.6	N/A	65.9	N/A	N/A
	Lennox	N/A	65.0	65.0	65.1	65.5	66.3	66.6	67.0	N/A
	Carrier	N/A	N/A	N/A	N/A	65.1	66.3	66.7	66.5	N/A
Oil Central Space Heater (AFUE %)	CS-179	73.6	N/A	N/A	N/A	75.0	N/A	76.0	N/A	N/A
Room Air Conditioner (EER)	CS-179	6.2	N/A	N/A	N/A	6.8	N/A	7.0	N/A	N/A
	AHAM	6.0	N/A	N/A	N/A	6.7	N/A	7.0	7.1	N/A
Central Air Conditioner (SEER)	CS-179	6.7	N/A	N/A	N/A	7.0	N/A	7.8	N/A	N/A
	Lennox	N/A	6.2	6.9	7.0	7.0	7.1	7.1	7.7	8.2
	ARJ	6.7	N/A	7.1	7.2	7.4	7.5	7.6	7.6	7.9
Electric Water Heater (Percent)	CS-179	79.8	N/A	N/A	N/A	80.7	N/A	81.3	N/A	N/A
Gas Water Heater (Percent)	CS-179	47.4	N/A	N/A	N/A	48.2	N/A	51.2	N/A	N/A
Refrigerator (Cu. Ft./kWh/Day)	CS-179	4.2	N/A	N/A	N/A	5.1	N/A	5.7	N/A	N/A
	AHAM	3.8	N/A	N/A	N/A	5.0	N/A	5.6	6.1	N/A
Freezer (Cu. Ft./kWh/Day)	CS-179	8.1	N/A	N/A	N/A	10.1	N/A	10.8	N/A	N/A
	AHAM	7.3	N/A	N/A	N/A	9.9	N/A	10.9	11.3	N/A

Source: The Behavior of the Energy Efficiency in the Purchase of Appliances and Home Heating and Cooling Equipment, Lawrence Berkeley Laboratory, Draft Report, February 1984.

TABLE 5.4 Efficiencies of New Appliances and Home Heating & Cooling Equipment Shipment Weighted Energy Factors (SWEF)

GCSH = Gas Central Space Heater OCSH = Oil-fired Central Space Heater
 RAC = Room Air Conditioner CAC = Central Air Conditioner FRZ = Freezer
 EWH = Electric Water Heater GWH = Gas Water Heater REF = Refrigerator

FIGURE 5.2 Percentage Improvements in Appliance Efficiency
Between 1972 and 1980

Remarks:

1. Figure 5.2 shows the percentage increase in energy efficiency for certain classes of home appliances between 1972 and 1980. The information is originally from CS-179, a US Department of Energy report.
2. Figure 5.2 demonstrates that there were wide discrepancies in efficiency improvements between the various appliance types. According to CE-179, the efficiency of refrigerators and freezers, as measured by shipment weighted energy factors, increased by 36% and 33%, respectively. On the other hand, the efficiency of electric water heaters increased by only 2% during the same period.
3. The information provided by Lennox, Carrier, AHAM, and ARI, which is also on Table 5.4, varies somewhat from the DOE data. Most significantly, the AHAM data for refrigerators and freezers indicates that their efficiencies increased by 47% and 49%, respectively, for the period of 1972-1980. The major difference with the DOE data is in the shipment weighted energy factors assigned to the appliances in 1972.

FIGURE 2.5 Percentage Improvement in Appliance Efficiency Between 1972 and 1980

Figure 2.5 shows the percentage increase in energy efficiency for certain classes of home appliances between 1972 and 1980. The information is originally from DOE-178, a US Department of Energy report.

Figure 2.5 demonstrates that there were also significant increases in efficiency improvements between the various appliance types. According to DOE-178, the efficiency of refrigerators and freezers, as measured by annual weighted energy factor, increased by 36% and 11%, respectively. On the other hand, the efficiency of electric water heaters increased by only 2% during the same period.

The information provided by Energy Conservation Act and Act, which is also in Table 2.4, varies somewhat from the DOE data. Most significantly, the AEA data for refrigerators and freezers indicates that their efficiency increased by 41% and 40%, respectively, for the period of 1972-1980. The major difference with the DOE data is in the different weighted energy factors assigned to the appliances in 1972.

CHAPTER SIX: RESIDENTIAL SECTOR ENERGY CONSUMPTION AND PRICES

This chapter provides information on the amount of energy consumed by the residential sector, the types of fuels consumed, their prices, and total energy-related expenditures made by the sector. Data for this chapter were taken primarily from

the Annual Energy Review, a publication of the Energy Information Administration, Facts on Major Home Appliance Energy Consumption and Efficiency Trends, a publication of the Association of Home Appliance Manufacturers, and The Behavior of Energy Efficiency in the Purchase of Appliances and Home Heating and Cooling Equipment, a publication of Lawrence Berkeley Laboratory. At the time that this edition of the Residential and Commercial Buildings Data Book was produced this was the most current information available.

This chapter is comprised of the following sections:

<u>Section Number</u>	<u>Section Title</u>	<u>Page Number</u>
6.1	Historical Residential Energy Consumption	6.2
6.2	Residential Energy Consumption per Household and per Capita	6.4
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6.4	Average Residential Energy Consumption: April 1982 through March 1983	6.8
6.5	Historical Energy Prices for the Residential Sector	6.12

6.1 HISTORIC RESIDENTIAL SECTOR ENERGY CONSUMPTION

Year	Coal	Gas	Petroleum	Electricity Sales	Total End - Use Energy Consumed	Electrical Energy Losses	Total Primary Energy Consumed
1960	405.0	3,211.8	2,265.3	687.4	6,569.5	1,717.0	8,286.5
1961	386.9	3,362.3	2,331.9	731.7	6,812.8	1,789.3	8,602.1
1962	354.3	3,600.3	2,440.9	794.3	7,189.8	1,914.7	9,104.5
1963	308.4	3,700.3	2,459.4	855.6	7,323.7	2,048.2	9,371.9
1964	270.8	3,908.5	2,375.0	927.5	7,481.8	2,211.0	9,692.8
1965	252.5	4,027.7	2,480.6	992.9	7,753.7	2,372.2	10,125.9
1966	244.3	4,274.8	2,470.7	1,081.2	8,071.0	2,594.8	10,665.8
1967	210.4	4,451.3	2,556.8	1,160.5	8,379.0	2,772.4	11,151.4
1968	190.5	4,588.3	2,685.2	1,301.9	8,765.9	3,106.4	11,872.3
1969	177.3	4,874.9	2,738.7	1,456.0	9,246.9	3,479.0	12,725.9
1970	152.3	4,987.4	2,755.2	1,591.0	9,485.9	3,863.3	13,349.2
1971	143.6	5,125.8	2,777.1	1,704.4	9,750.9	4,129.0	13,879.9
1972	110.3	5,264.4	2,895.4	1,837.7	10,107.8	4,419.5	14,527.3
1973	108.1	4,977.0	2,825.2	1,976.3	9,886.6	4,738.3	14,624.9
1974	106.0	4,901.0	2,573.5	1,972.8	9,553.3	4,815.8	14,369.1
1975	86.5	5,022.6	2,494.9	2,006.7	9,610.7	4,845.8	14,456.5
1976	83.9	5,147.3	2,720.4	2,069.2	10,020.8	4,984.8	15,005.6
1977	84.5	4,913.1	2,695.0	2,201.6	9,894.2	5,317.7	15,211.9
1978	85.3	4,981.5	2,619.9	2,301.3	9,988.0	5,633.1	15,621.1
1979	74.3	5,054.7	2,113.7	2,329.8	9,572.5	5,626.3	15,198.8
1980	61.3	4,866.1	1,747.9	2,448.1	9,123.4	5,956.5	15,079.9
1981	72.9	4,664.7	1,543.4	2,464.4	8,745.4	5,873.9	14,619.3
1982	77.6	4,753.5	1,441.0	2,489.1	8,761.2	5,976.1	14,737.3
1983	77.7	4,516.4	1,434.3	2,562.2	8,590.6	6,145.7	14,736.3
1984e	84.0	4,792.0	1,509.0	2,647.0	9,032.0	6,233.0	15,266.0

Source: State Energy Data Report, U.S. DOE/EIA, May 1985.

Note: e = estimated. Residential and commercial data based on ratios for residential and commercial consumption to total combined residential/commercial consumption as contained in the State Energy Data Report, May 1985, updated with 1984 information from the Monthly Energy Review, U.S. DOE/EIA, April 1985. Industrial and transportation data from the Monthly Energy Review, April 1985.

TABLE 6.1 Residential Sector Energy Consumption, by Fuel Type (Trillion BTUs)

FIGURE 6.1 Total Primary Energy Consumption by the Residential Sector 1960 - 1984

FIGURE 6.2 Residential Sector Energy Consumption by Fuel Type
1960 - 1984

Remarks:

1. Between 1960 and 1984 primary energy consumption by the residential sector almost doubled, rising from about 8 trillion BTUs to over 15 trillion, an average annual increase of 2.62%. This period can be reasonably divided at the year 1973, however. Between 1960 and 1973, residential energy consumption increased at an average annual rate of 4.48%. After 1973, residential consumption increased at a rate of only 0.48%. In the latter period the percentage change ranged from -3.05% to 3.80%.
2. Each of the four major fuel types (electricity, natural gas, petroleum, and coal) has undergone major changes in usage between 1960 and 1984. During this period electricity doubled its share of total primary energy consumed by the residential sector, going from 29% to 58%. The shares of all the other fuels declined. Because of the overall growth in energy consumption during this period, this change in electricity consumption (including losses) represents an increase in total consumption of approximately 270%.

6.2 RESIDENTIAL SECTOR ENERGY CONSUMPTION PER HOUSEHOLD AND PER CAPITA

Year	Number of Households (Mil Units)	Fossil Fuel Consumption (Tril Btu)	Fossil Fuel Consumption Per Household (Mil Btu)	Electricity Consumption Inc. Losses (Tril Btu)	Electricity Consumption Per Household (Mil Btu)	Total Primary Energy Consumption (Tril Btu)	Consumption Per Household (Mil Btu)
1960	52.8	5,882.1	111.4	2,404.4	45.5	8,286.5	156.9
1961	53.6	6,081.1	113.5	2,521.0	47.1	8,602.1	160.6
1962	54.8	6,395.5	116.8	2,709.0	49.5	9,104.5	166.3
1963	55.3	6,468.1	117.0	2,903.8	52.5	9,371.9	169.6
1964	56.2	6,554.3	116.7	3,138.5	55.9	9,692.8	172.6
1965	57.4	6,760.8	117.7	3,365.1	58.6	10,125.9	176.3
1966	58.4	6,989.8	119.7	3,676.0	62.9	10,665.8	182.6
1967	59.2	7,218.5	121.9	3,932.9	66.4	11,151.4	188.2
1968	60.8	7,464.0	122.7	4,408.3	72.5	11,872.3	195.2
1969	62.2	7,790.9	125.2	4,935.0	79.3	12,725.9	204.6
1970	63.4	7,894.9	124.5	5,454.3	86.0	13,349.2	210.6
1971	64.8	8,046.5	124.2	5,833.4	90.0	13,879.9	214.3
1972	66.7	8,270.1	124.0	6,257.2	93.8	14,527.3	217.9
1973	68.3	7,910.3	115.9	6,714.6	98.4	14,624.9	214.3
1974	69.9	7,580.5	108.5	6,788.6	97.2	14,369.1	205.7
1975	71.1	7,604.0	106.9	6,852.5	96.4	14,456.5	203.3
1976	72.9	7,951.6	109.1	7,054.0	96.8	15,005.6	205.9
1977	74.1	7,692.6	103.8	7,519.3	101.4	15,211.9	205.2
1978	76.1	7,686.7	101.0	7,934.4	104.2	15,621.1	205.2
1979	77.3	7,242.7	93.7	7,956.1	102.9	15,198.8	196.5
1980	80.8	6,675.3	82.6	8,404.6	104.0	15,079.9	186.7
1981	82.4	6,281.0	76.3	8,338.3	101.2	14,619.3	177.5
1982	83.5	6,272.1	75.1	8,465.2	101.3	14,737.3	176.4
1983	83.9	6,028.4	71.8	8,707.9	103.8	14,736.3	175.6
1984 ^e	85.0	6,385.0	75.1	8,880.0	104.5	15,266.0	179.6

Source: State Energy Data Report, U.S. DOE/EIA, May 1985. Housing data from the Current Population Series, P-20, U.S. Bureau of Census, various issues.

Note: e = estimated. Residential consumption data based on ratios for residential and commercial consumption to total combined residential/commercial consumption as contained in the State Energy Data Report, May 1985, updated with 1984 information from the Monthly Energy Review, U.S. DOE/EIA, April 1985.

TABLE 6.2 Residential Sector Energy Consumption per Household (Trillion BTUs)

Year	Population (Millions)	Fossil Fuel Consumption (Tril Btu)	Fossil Fuel Consumption Per Capita (Mil Btu)	Electricity Consumption Inc. Losses (Tril Btu)	Electricity Consumption Per Capita (Mil Btu)	Total Primary Energy Consumption (Tril Btu)	Total Consumption Per Capita (Mil Btu)
1960	180.0	5,882.1	32.7	2,404.4	13.4	8,286.5	46.0
1961	183.0	6,081.1	33.2	2,521.0	13.8	8,602.1	47.0
1962	185.8	6,395.5	34.4	2,709.0	14.6	9,104.5	49.0
1963	188.5	6,468.1	34.3	2,903.8	15.4	9,371.9	49.7
1964	191.1	6,554.3	34.3	3,138.5	16.4	9,692.8	50.7
1965	193.5	6,760.8	34.9	3,365.1	17.4	10,125.9	52.3
1966	195.6	6,989.8	35.7	3,676.0	18.8	10,665.8	54.5
1967	197.5	7,218.5	36.5	3,932.9	19.9	11,151.4	56.5
1968	199.4	7,464.0	37.4	4,408.3	22.1	11,872.3	59.5
1969	201.4	7,790.9	38.7	4,935.0	24.5	12,725.9	63.2
1970	204.0	7,894.9	38.7	5,454.3	26.7	13,349.2	65.4
1971	206.8	8,046.5	38.9	5,833.4	28.2	13,879.9	67.1
1972	209.3	8,270.1	39.5	6,257.2	29.9	14,527.3	69.4
1973	211.4	7,910.3	37.4	6,714.6	31.8	14,624.9	69.2
1974	213.3	7,580.5	35.5	6,788.6	31.8	14,369.1	67.4
1975	215.5	7,604.0	35.3	6,852.5	31.8	14,456.5	67.1
1976	217.5	7,951.6	36.6	7,054.0	32.4	15,005.6	69.0
1977	219.8	7,692.6	35.0	7,519.3	34.2	15,211.9	69.2
1978	222.1	7,686.7	34.6	7,934.4	35.7	15,621.1	70.3
1979	224.6	7,242.7	32.2	7,956.1	35.4	15,198.8	67.7
1980	227.2	6,675.3	29.4	8,404.6	37.0	15,079.9	66.4
1981	229.5	6,281.0	27.4	8,338.3	36.3	14,619.3	63.7
1982	231.8	6,272.1	27.1	8,465.2	36.5	14,737.3	63.6
1983	234.0	6,028.4	25.8	8,707.9	37.2	14,736.3	63.0
1984e	236.2	6,385.0	27.0	8,880.0	37.6	15,265.0	64.6

Source: State Energy Data Report, U.S. DOE/EIA, May 1985. Population from the Annual Energy Review, U.S. DOE/EIA, April 1985.

Note: e = estimated. Residential and commercial data based on ratios for residential and commercial consumption to total combined residential/commercial consumption as contained in the State Energy Data Report, May 1985, updated with 1984 information from the Monthly Energy Review, U.S. DOE/EIA, April 1985.

TABLE 6.3 Residential Sector Energy Consumption per Household
(Trillion BTUs)

FIGURE 6.3 A Comparison of Energy Consumption per Household and per Capita

Remarks:

1. Figure 6.4 displays the indexed values for energy consumption per capita and energy consumption per household. These index values were derived by multiplying the all figures for energy consumption per capita and energy consumption per household by their respective quantities as of 1960, thus setting the index for each at a value of "1" for that year.
2. Figure 6.4 indicates that, while consumption per household has declined substantially since 1973, consumption per capita has not. This suggests several things. First, that efforts since 1973 to reduce household energy consumption through energy conservation and improved efficiency have succeeded. Second, that the decline in consumption per household is also related to the decline in population per household. That is, that because the average household now has fewer occupants than in the past (2.8 occupants per household in 1984 versus 3.4 in 1960), it thus requires less total energy.

6.3 TOTAL RESIDENTIAL SECTOR ENERGY CONSUMPTION, APRIL 1982 - MARCH 1983

Housing Characteristics	Number of Households (millions)	All Fuels (Quad Btu)	Natural Gas (Quad Btu)	Electricity (Quad Btu)	Fuel Oil or Kerosene (Quad Btu)	LPG (Quad Btu)
Total Households	83.80	8.62	4.77	2.42	1.14	0.29
Type of Housing Structure						
Single Family or Mobile Home	61.40	6.74	3.71	1.97	0.78	0.24
2 or More Units	22.30	1.89	1.07	0.46	0.35	Q
Measured Heating Space of Residence (sq. ft.)						
Less than 999	30.30	2.29	1.23	0.64	0.32	0.10
1,000 to 1,999	35.60	3.71	2.02	1.11	0.47	0.12
2,000 or More	17.80	2.62	1.53	0.67	0.35	0.07
Year House Built						
1950 or Earlier	30.60	3.48	2.02	0.66	0.68	0.12
1950 to 1974	40.20	4.08	2.32	1.25	0.38	0.12
1974 or Later	12.90	1.07	0.44	0.51	0.07	0.05
Main Heating Fuel						
Natural Gas	47.50	5.62	4.53	1.07	0.01	Q
Electricity	13.40	0.83	0.08	0.73	0.01	0.01
Fuel Oil or Kerosene	12.00	1.44	0.12	0.27	1.04	0.01
Other	10.80	0.73	0.04	0.35	0.08	0.27
Hot Water Fuel						
Natural Gas	47.10	5.56	4.37	1.03	0.16	Q
Electricity	26.60	2.00	0.35	1.20	0.35	0.10
Fuel Oil or Kerosene	5.40	0.73	0.06	0.09	0.57	Q
Other	4.40	0.34	Q	0.10	0.05	0.19

Note: Q = data withheld because of large variances.

Source: RECS: Consumption and Expenditures, April 1982 through March 1983, Part 2 - Regional Data, U.S. DOE/EIA, December 1984.

TABLE 6.4 Total Residential Sector Energy Consumption for the U.S.
April 1982 through March 1983

Remarks:

1. Single family homes and older residences use proportionately more energy than do mobile homes, multi-family units, and newer residences. Also, homes in the Northeast and North Central regions use proportionately more energy than do homes in the South and the West.
2. Households which use natural gas or fuel oil as the main heating use proportionately more energy than do households which use electricity or other fuels for space heating. This is mostly likely due to associated geographic factors (e.g., most of the homes which use fuel oil are in the colder regions) and dwelling units types (e.g., a high percentage of the homes which use electricity are multi-family units.)
3. Figure 6.6 indicates that North Central region is the largest user of natural gas, but that the other regions are also substantial users. It also indicates that South is the largest user of electricity while the Northeast is the largest user of fuel oil and/or kerosene.

6.4 AVERAGE RESIDENTIAL ENERGY CONSUMPTION

	TYPE OF HEATING FUEL									
	All Households		Gas		Electricity		Oil or Kerosene		LPG	
	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)
Total Households	83.8	103	47.5	118	13.4	62	12.0	125	3.8	86
Type of Housing Structure										
Mobile Homes	3.7	72	1.1	91	0.9	50	0.6	80	0.9	73
Single Family Homes	57.7	112	33.2	122	7.4	70	7.6	130	2.8	91
2 or More Units	22.4	84	13.2	87	4.9	52	3.8	122	0	0
Measured Heating Space of Residence (sq. Ft.)										
Less than 999	30.2	76	16.7	84	5.7	49	4.1	105	1.7	66
1,000 to 1,999	35.6	104	19.9	121	5.8	65	5.0	124	1.5	90
2,000 or More	17.9	147	10.8	167	1.9	90	3.0	156	0.5	139
Year House Built										
1950 or Earlier	30.6	114	18.4	122	1.1	59	6.8	134	1.4	89
1950 to 1974	40.2	101	24.5	117	6.6	62	4.4	114	1.7	83
1974 or Later	12.9	83	4.7	111	5.7	61	0.8	110	0.7	87

Notes: Q = data withheld because of large variances.

Sources: RES: Consumption and Expenditures, April 1982 through March 1983, Part 2 - Regional Data, U.S. DOE/EIA, December 1984.

TABLE 6.5 Average Energy Consumption for All U.S. Households 1982

	TYPE OF HEATING FUEL									
	All Households		Gas		Electricity		Oil or Kerosene		LPG	
	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)
Total Households	18.0	122	7.5	134	1.3	51	7.6	135	0	78
Type of Housing Structure										
Mobile Homes	0.4	93	0	0	0	0	0.2	103	0	0
Single Family Homes	10.6	134	4.5	159	0.7	60	4.0	145	0	0
2 or More Units	7.0	104	2.9	98	0.6	41	3.3	124	0	0
Measured Heating Space of Residence (sq. Ft.)										
Less than 999	6.0	93	2.2	89	0.6	41	2.7	115	0	0
1,000 to 1,999	7.1	124	3.2	137	0.5	56	2.9	135	0	0
2,000 or More	4.8	153	2.1	177	0.2	69	1.9	162	0	0
Year House Built										
1950 or Earlier	9.4	126	3.9	127	0.2	51	4.5	140	0	0
1950 to 1974	7.1	120	3.2	140	0.7	50	2.5	128	0	0
1974 or Later	4.8	102	0.4	162	0.5	52	0.5	120	0	0

Notes: Q = data withheld because of large variances.

Sources: RES: Consumption and Expenditures, April 1982 through March 1983, Part 2 - Regional Data, U.S. DOE/EIA, December 1984.

TABLE 6.6 Average Residential Energy Consumption in the Northeast Region 1982

	TYPE OF HEATING FUEL									
	All Households		Gas		Electricity		Oil or Kerosene		LPG	
	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)
Total Households	21.3	122	15.5 ¹	133	2.1	73	1.6	128	1.0	121
Type of Housing Structure										
Mobile Homes	0.7	88	0.2	107	0	0	0	0	0.2	81
Single Family Homes	15.0	134	10.7	148	1.2	86	1.2	132	0.8	131
2 or More Units	5.6	95	4.6	100	0.8	54	0.3	118	0	0
Measured Heating Space of Residence (sq. ft.)										
Less than 999	6.8	89	5.2	96	0.9	58	0.3	105	0.2	85
1,000 to 1,999	8.1	122	5.7	134	0.7	78	0.8	122	0.4	115
2,000 or More	6.3	157	4.6	173	0.5	95	0.5	156	0.3	158
Year House Built										
1950 or Earlier	9.3	134	7.4	140	0	0	0.9	143	0.4	131
1950 to 1974	9.2	116	6.8	128	1.2	72	0.4	110	0.4	109
1974 or Later	2.9	100	1.3	121	0.8	75	0.2	99	0	0

Notes: 0 = data withheld because of large variances.

Sources: BECS: Consumption and Expenditures, April 1982 through March 1983, Part 2 - Regional Data.
U.S. DOE/EIA, December 1984.

TABLE 6.7 Average Residential Energy Consumption in the North Central Region 1982

	TYPE OF HEATING FUEL									
	All Households		Gas		Electricity		Oil or Kerosene		LPG	
	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)
Total Households	28.1	88	13.3	112	6.8	61	2.5	98	2.3	71
Type of Housing Structure										
Mobile Homes	1.8	57	0.3	81	0.6	43	0.3	61	0.5	66
Single Family Homes	20.9	96	10.2	122	4.0	69	1.9	104	1.8	73
2 or More Units	5.4	68	2.9	78	2.2	53	0.2	103	0	0
Measured Heating Space of Residence (sq. ft.)										
Less than 999	10.5	66	4.9	81	2.8	49	0.9	76	1.1	59
1,000 to 1,999	13.2	90	6.0	117	3.2	66	1.1	99	1.0	80
2,000 or More	4.2	136	2.3	166	0.8	87	0.5	138	0	0
Year House Built										
1950 or Earlier	7.7	89	4.0	107	0.5	58	1.1	108	0.9	75
1950 to 1974	15.6	91	8.1	115	3.7	62	1.3	90	1.1	69
1974 or Later	4.7	76	1.3	111	2.6	61	0	0	0.3	69

Notes: 0 = data withheld because of large variances.

Sources: BECS: Consumption and Expenditures, April 1982 through March 1983, Part 2 - Regional Data.
U.S. DOE/EIA, December 1984.

TABLE 6.8 Average Residential Energy Consumption in the Southern Region 1982

	TYPE OF HEATING FUEL									
	All Households		Gas		Electricity		Oil or Kerosene		LP	
	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)	Number of Households (millions)	Avg. Amount Consumed Per Household (millions Btu)
Total Households	16.5	84	11.1	94	3.1	59	0.4	99	0.4	88
Type of Housing Structure										
Mobile Homes	0.9	81	0.5	90	0	0	0	0	0.2	86
Single Family Homes	11.2	94	7.8	105	1.6	65	0.4	99	0.2	90
2 or More Units	4.5	59	2.9	63	1.4	53	0	0	0	0
Measured Heating Space of Residence (sq. ft.)										
Less than 999	6.9	62	4.4	69	1.4	46	0	0	0.2	70
1,000 to 1,999	7.1	90	5.0	100	1.4	60	0.2	98	0	0
2,000 or More	2.5	128	1.7	142	0.4	105	0	0	0	0
Year House Built										
1950 or Earlier	4.3	85	3.1	93	0.3	61	0.3	95	0	0
1950 to 1974	8.4	89	6.4	96	1.1	61	0.2	105	0	0
1974 or Later	3.8	71	1.6	90	1.7	58	0	0	0.2	86

Notes: 0 = data withheld because of large variances.

Sources: RECS, Consumption and Expenditures, April 1982 through March 1983, Part 2 - Regional Data, U.S. DOE/EIA, December 1984.

TABLE 6.9 Average Residential Energy Consumption in the Western Region 1982

FIGURE 6.4 Average Residential Energy Consumption by Region and Housing Type, 1982

Remarks:

1. Single family homes consume the highest average number of BTUs per household (112 million); mobile homes consume the fewest (72 million).
2. Older residences and larger residences have a higher average consumption of BTUs than do newer and smaller residences.
3. Dwellings of all types in the South and West consume a lower average number of BTUs than do similar buildings in the Northeast and North Central regions. The increased cooling load in the South does not increase energy consumption to the higher levels experienced in the Northeast.

6.5 ENERGY PRICES FOR THE RESIDENTIAL SECTOR: 1970 THROUGH 1982

Year	Coal	Natural Gas	Distillate Fuel	Kerosene	LPG and Ethane	Electricity	Residential Average (a)
1970	0.86	2.59	3.25	3.76	5.11	15.95	5.13
1971	2.26	2.61	3.28	3.70	4.77	15.87	5.21
1972	2.35	2.66	3.15	3.55	4.83	15.89	5.32
1973	2.47	2.66	3.47	3.95	7.65	15.74	5.77
1974	4.19	2.76	5.07	5.69	7.24	17.63	6.60
1975	4.25	2.97	4.87	5.58	7.14	18.30	6.82
1976	3.90	3.28	4.96	5.61	7.41	18.52	7.04
1977	3.97	3.69	5.30	6.03	7.83	18.99	7.69
1978	3.80	3.71	5.29	6.00	7.07	18.79	7.71
1979	3.38	3.98	6.60	7.67	8.96	18.64	8.22
1980	3.41	4.51	8.82	9.98	9.89	19.70	9.46
1981	3.80	4.79	9.96	12.03	9.50	20.77	10.20
1982	3.59	5.44	9.19	11.17	9.98	21.47	10.65

Note: Data do not include expenditures for wood-derived fuels or renewable energy sources.

Source: State Energy Price and Expenditure Report: 1970 - 1982. DOE/EIA.

TABLE 6.10 Fuel Prices for the Residential Sector, in Constant Dollars (1984 Dollars per Million BTUs)

FIGURE 6.5 Fuel Prices for the Residential Sector, in Constant Dollars (1984 Dollars per Million BTUs)

CHAPTER SEVEN: CHARACTERISTICS OF U.S. COMMERCIAL BUILDINGS

This chapter provides general information on energy-related characteristics of all commercial buildings in the U.S.. Data for this chapter was taken primarily from Characteristics of Commercial Buildings 1983, a publication of the Energy Information Administration of the U.S. Department of Energy. The information in that publication was drawn in turn from the 1983 Nonresidential Buildings Energy Consumption Survey.

This chapter is comprised of the following sections:

<u>Section Number</u>	<u>Section Title</u>	<u>Page Number</u>
7.1	Types and Sizes of Commercial Buildings in the U.S.	7.2
7.2	Space Heating Fuel Usage in U.S. Commercial Buildings	7.14
7.3	Heating Systems Used in U.S. Commercial Buildings, 1983	7.18
7.4	Heat Distribution Systems Used in U.S. Commercial Buildings, 1983	7.22
7.5	Cooling Fuels and Systems Used in U.S. Commercial Buildings, 1983	7.26
7.6	Energy Conservation in U.S. Commercial Buildings, 1983	7.30

7.1 TYPES AND SIZES OF COMMERCIAL BUILDINGS IN THE U.S.

Building Categories	All Buildings	Assembly	Educational	Food Service & Sales	Health Care	Lodging	Mercantile & Services	Office	Residential	Warehouse	Other	Vacant
United States												
Number of Buildings	3,948	457	177	380	61	106	1,071	575	236	425	179	281
Total Square Footage	52,325	5,483	6,044	2,051	2,277	2,241	10,427	8,454	2,454	6,791	2,760	3,342
Average Square Footage	13.3	12.0	34.2	5.4	37.3	21.1	9.7	14.7	10.4	16.0	15.9	11.9
% of Total Buildings	100.0	11.6	4.5	9.6	1.5	2.7	27.1	14.6	6.0	10.8	4.5	7.1
% of Total Sq. Ft.	100.0	10.5	11.6	3.9	4.4	4.3	19.9	16.2	4.7	13.0	5.3	6.4
Northeast Region												
Number of Buildings	670	61	28	58	11	13	183	97	97	57	20	46
Total Square Footage	11,615	1,053	1,374	392	502	422	2,040	1,774	1,336	1,224	834	664
Average Square Footage	17.3	17.3	49.1	6.8	45.6	32.5	11.1	18.3	13.8	21.5	41.7	14.4
% of Total Buildings	17.0	9.1	4.2	8.7	1.6	1.9	27.3	14.5	14.5	8.5	3.0	6.9
% of Total Sq. Ft.	22.2	9.1	11.8	3.4	4.3	3.6	17.6	15.3	11.5	10.5	7.2	5.7
North Central Region												
Number of Buildings	1,211	149	39	120	21	12	353	176	78	131	50	80
Total Square Footage	16,059	1,755	1,834	724	1,015	669	3,219	2,178	717	2,130	881	937
Average Square Footage	13.3	11.8	47.0	6.0	48.3	55.8	9.1	12.4	9.2	16.3	17.6	11.7
% of Total Buildings	30.7	12.3	3.2	9.9	1.7	1.0	29.1	14.5	6.4	10.8	4.1	6.6
% of Total Sq. Ft.	30.7	10.9	11.4	4.5	6.3	4.2	20.0	13.6	4.5	13.3	5.5	5.8
South Region												
Number of Buildings	1,493	202	79	145	20	57	383	191	44	170	87	114
Total Square Footage	17,049	1,835	2,082	616	567	803	3,843	2,903	299	2,288	644	1,169
Average Square Footage	11.4	9.1	26.4	4.2	28.4	14.1	10.0	15.2	6.8	13.5	7.4	10.3
% of Total Buildings	37.8	13.5	5.3	9.7	1.3	3.8	25.7	12.8	2.9	11.4	5.8	7.6
% of Total Sq. Ft.	32.6	10.8	12.2	3.6	3.3	4.7	22.5	17.0	1.8	13.4	3.8	6.9
West Region												
Number of Buildings	574	45	31	57	0	24	151	112	16	68	22	41
Total Square Footage	7,602	0	754	320	193	346	1,325	1,599	103	1,149	402	571
Average Square Footage	13.2	0.0	24.3	5.6	0	14.4	8.8	14.3	6.4	16.9	18.3	13.9
% of Total Buildings	14.5	7.8	5.4	9.9	0	4.2	26.3	19.5	2.8	11.8	3.8	7.1
% of Total Sq. Ft.	14.5	0	9.9	4.2	2.5	4.6	17.4	21.0	1.4	15.1	5.3	7.5

MC = No cases in sample.

Q = Data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983. U.S. DOE/EIA, July 1985.

TABLE 7.1 Commercial Building Types in the U.S. and the Four Census Regions, 1983
(Thousands of Buildings, Millions of Total Square Feet, and Average Square Feet of Floor Space, in Thousands)

KEY:

AS - Assembly	HC - Health Care	OF - Office	OT - Other
ED - Education	LO - Lodging	RS - Residential	VA - Vacant
FS - Food Sales & Service	MS - Mercantile Sales	WS - Warehouse & Storage	

FIGURE 7.1 Number and Sizes of U.S. Commercial Building Types

EXPLANATIONS OF BUILDING TYPES

The categories of building types used here are identical to those used by the Energy Information Administration (EIA). In general, the EIA has classified commercial buildings on the basis of the principal activity carried out within the building. An activity's relative weight is determined according to amount of floor space, described in square footage, devoted to that activity. Thus, for example, a building which contains both a cafeteria and some offices will be classified as a Food Sales and Service Building if more of the building's square footage is devoted to the cafeteria, or as an Office Building if more of its square footage is devoted to the offices.

BUILDING TYPES

Assembly buildings are used for gatherings of 50 or more people for social, recreational, and religious activities (e.g., churches, bowling alleys, clubs).

Education buildings are those used for academic or technical instruction.

Food Sales and Service buildings include retail food sales operations (e.g., supermarkets) and food service buildings (e.g., cafeterias, restaurants).

Health Care buildings house diagnostic and treatment facilities for both in-patient and out-patient care for both the mentally and physically ill. Facilities for overnight care are included in this category.

Lodging buildings offer multiple accommodations to long and short-term residents. This category includes boarding houses, nursing homes, and dormitories as well as hotels and motels. It does not include multi-family apartment buildings, however.

Mercantile Sales and Personal Services buildings house wholesale and retail sales operations for goods and services other than food. Included are shopping malls, individual retail stores, laundries, post offices, and service stations, among others.

Office buildings contain professional, administrative, and/or other office space.

Residential buildings must have some commercial activity as well in order to be included here. A building is classified as residential only if more square footage is devoted to residential use than to any single commercial use.

Warehouse and Storage buildings are used to store goods, merchandise, raw materials and/or manufactured products.

Vacant buildings are those which have the predominant (but not necessarily entire) proportion of their floor space unused at the time of the EIA survey.

Other buildings constitute a residual category. Included here are such things as crematoria, parking garages, police stations, and reformatories.

Remarks:

1. In 1983 there were a total of 3,948,000 commercial buildings with a total floor space of 52.3 billion square feet. By comparison there were 57.7 million single family homes, 29.9 million multi-family buildings, and 4.0 million mobile homes in the US.
2. Mercantile and Services Buildings were the single most common type of commercial building, comprising 27% of all commercial buildings. They also had the single largest percentage of total commercial floor space, 20%, although this is considerably lower than their percentage for the number of buildings. Retail and Service Building rank next to last in average square feet per building (9,700 ave. sq. ft.).
3. Office Buildings were the second most common type of commercial building (15%). They also comprised the second largest share of commercial floor space (16%), giving them an average of 14,700 square feet per building.
4. Seven percent of the buildings, representing 6% of total commercial sector floor space was categorized as vacant.
5. Over half of all commercial buildings fall into the smallest square footage category -- less than 5,000 square feet. Distribution is fairly standard over most of the building types. The largest buildings -- those over 100,000 square feet -- tend to be Education, Health Care, Mercantile and Services, Office, and Warehouse Buildings. Although the Assembly Building category includes such buildings as stadiums and sports complexes.

Building Categories	All Buildings	5,000 or Less	5,001 to 10,000	10,001 to 25,000	25,001 to 50,000	50,001 to 100,000	100,001 to 200,000	Over 200,000
Number of Buildings:								
All Buildings	3,948	2,248	725	567	222	107	50	29
Period of Construction								
1900 or Before	288	153	61	51	16	4	0	1
1901 to 1920	388	187	85	65	29	14	5	2
1921 to 1945	726	413	131	106	48	14	9	4
1946 to 1960	946	601	174	110	28	19	8	6
1961 to 1970	721	429	126	87	39	23	12	6
1971 to 1973	209	103	43	32	18	8	4	1
1974 to 1979	530	313	83	82	30	13	6	3
1980 to 1983	140	49	22	33	14	12	4	6
Total Square Footages:								
All Buildings	52,325	4,809	5,246	8,912	7,692	7,168	6,642	11,757
Period of Construction								
1900 or Before	2,940	406	440	767	530	281	0	409
1901 to 1920	5,453	514	600	1,049	1,010	942	636	701
1921 to 1945	8,639	855	950	1,663	1,656	949	1,251	1,315
1946 to 1960	9,612	1,187	1,279	1,699	964	1,265	1,062	2,157
1961 to 1970	9,947	881	860	1,417	1,371	1,533	1,664	2,221
1971 to 1973	3,442	249	320	496	654	556	559	609
1974 to 1979	6,616	688	635	1,298	1,029	848	773	1,345
1980 to 1983	5,675	127	163	523	479	794	590	3,000
Percentage of Buildings:								
All Buildings	100.0	56.9	18.4	14.4	5.6	2.7	1.3	0.7
Period of Construction								
1900 or Before	7.3	53.1	21.2	17.7	5.6	1.4	0	0.3
1901 to 1920	9.8	48.2	21.9	16.8	7.5	3.6	1.3	0.5
1921 to 1945	18.4	56.9	18.0	14.6	6.6	1.9	1.2	0.6
1946 to 1960	24.0	63.5	18.4	11.6	3.0	2.0	0.8	0.6
1961 to 1970	18.3	59.5	17.5	12.1	5.4	3.2	1.7	0.8
1971 to 1973	5.3	49.3	20.6	15.3	8.6	3.8	1.9	0.5
1974 to 1979	13.4	59.1	15.7	15.5	5.7	2.5	1.1	0.6
1980 to 1983	3.5	35.0	15.7	23.6	10.0	8.6	2.9	4.3
Total Square Footages:								
All Buildings	100.0	9.2	10.0	17.0	14.7	13.7	12.7	22.5
Period of Construction								
1900 or Before	5.6	13.8	15.0	26.1	18.0	9.6	0	13.9
1901 to 1920	10.4	9.4	11.0	19.2	18.5	17.3	11.7	12.9
1921 to 1945	16.5	9.9	11.0	19.2	19.2	11.0	14.5	15.2
1946 to 1960	18.4	12.3	13.3	17.7	10.0	13.2	11.0	22.4
1961 to 1970	19.0	8.9	8.6	14.2	13.8	15.4	16.7	22.3
1971 to 1973	6.6	7.2	9.3	14.4	19.0	16.2	16.2	17.7
1974 to 1979	12.6	10.4	9.6	19.6	15.6	12.8	11.7	20.3
1980 to 1983	10.8	2.2	2.9	9.2	8.4	14.0	10.4	52.9

TABLE 7.2 Commercial Building Types by Period of Construction
(Thousands of Buildings, Millions of Total Square Feet,
and Thousands of Average Square Feet)

FIGURE 7.2 Commercial Buildings and Total Square Footage, by Period of Construction

Remarks:

1. In the most recent period, (1980 - 1983) new commercial buildings averaged 40,500 square feet per building. The period with the next highest average (1971 - 1973), had only 16,500 square feet per building. All of the building types except for educational buildings tended to be much larger than average during the 1980 - 1983 period. With the exception of this period, however, buildings constructed in more distant periods have about the same average square footage as those constructed more recently.
2. It should be noted that the periods vary considerably in time span. The period of 1921 through 1945 is comprised of twenty-four years; the period of 1971 through 1973 has only three. Thus, although figure 7.3 shows the earlier period as the most buildings in total, the latter period has more than twice as many constructed on a per year basis.

Building Categories	All Buildings	Assembly	Educational	Food Service & Sales	Health Care	Lodging	Mercantile & Services	Office	Residential	Warehouse	Other	Vacant
Fuels Used Alone or in Combination												
Electricity	3,783	452	177	380	59	106	1,059	575	235	387	169	183
Natural Gas	2,314	271	115	235	37	67	674	352	187	198	73	103
Fuel Oil	633	97	37	43	14	17	194	76	60	50	26	Q
Propane	260	51	7	41	Q	12	75	16	Q	20	Q	Q
Purchased Steam	60	8	8	Q	Q	10	3	9	Q	Q	6	5
Other	245	25	8	38	2	7	77	22	Q	14	25	10
Percentage Distribution of Fuels Used, by Building Type												
Electricity	95.8	98.9	100.0	100.0	96.7	100.0	98.9	100.0	99.6	91.1	94.4	65.1
Natural Gas	58.6	59.3	65.0	61.8	60.7	63.2	62.9	61.2	79.2	46.6	40.8	36.7
Fuel Oil	16.0	21.2	20.9	11.3	23.0	16.0	18.1	13.2	25.4	11.8	14.5	Q
Propane	6.6	11.2	4.0	10.8	Q	11.3	7.0	2.8	Q	4.7	Q	Q
Purchased Steam	1.5	1.8	4.5	Q	Q	9.4	0.3	1.6	Q	Q	3.4	1.8
Other	6.2	5.5	4.5	10.0	3.3	6.6	7.2	3.8	Q	3.3	14.0	3.6
Heated Building Area												
Not Heated	440	Q	Q	Q	MC	Q	89	Q	Q	126	39	144
1% to 50%	517	23	Q	39	Q	Q	165	44	Q	148	34	45
51% to 99%	564	49	22	76	Q	11	190	105	43	24	16	20
100%	2,427	370	149	251	49	88	627	417	186	127	90	72
Percentage Distribution												
Not Heated	11.1	Q	Q	Q	MC	Q	8.3	Q	Q	29.6	21.8	51.2
1% to 50%	13.1	5.0	Q	10.3	Q	Q	15.4	7.7	Q	34.8	19.0	16.0
51% to 99%	14.3	10.7	12.4	20.0	Q	10.4	17.7	18.3	18.2	5.6	8.9	7.1
100%	61.5	81.0	84.2	66.1	80.3	83.0	58.5	72.5	78.8	29.9	50.3	25.6
Cooled Building Area												
Not Cooled	1,304	161	47	66	Q	28	412	50	72	195	81	187
1% to 50%	1,004	81	45	74	20	7	311	106	84	185	38	62
51% to 99%	510	52	27	92	10	21	115	123	24	14	21	12
100%	1,129	163	58	148	25	51	232	297	55	31	39	30
Percentage Distribution												
Not Cooled	33.0	35.2	26.6	17.4	Q	26.4	38.5	8.7	30.5	45.9	45.3	66.5
1% to 50%	25.4	17.7	25.4	19.5	32.8	6.6	29.0	18.4	35.6	43.5	21.2	18.5
51% to 99%	12.9	11.4	15.3	24.2	16.4	19.8	10.7	21.4	10.2	3.3	11.7	4.3
100%	28.6	35.7	32.8	38.9	41.0	48.1	21.7	51.7	23.3	7.3	21.8	10.7

MC = no cases in sample.

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983. U.S. DOE/EIA, July 1985.

TABLE 7.3 Commercial Building Types by Square Footage Category, 1983
(Thousands of Buildings, Millions of Total Square Feet, and
Thousands of Average Square Feet)

FIGURE 7.3 Number and Total Square Footage of Commercial Buildings, by Square Footage Category

Remarks:

1. Over half (57%) of all commercial buildings in the U.S. have 5,000 or fewer square feet of floor space. Despite their overwhelming numbers, however, they account for only 9% of all commercial floor space in the U.S. Conversely, less than 1% of all buildings in the U.S. have over 200,000 square feet of floor space, yet these buildings account for 23% of the total commercial square footage.

Building Categories	All Buildings	Assembly	Educational	Food Service & Sales	Health Care	Lodging	Mercantile & Services	Office	Residential	Warehouse	Other	Total
Number of Buildings												
5,000 or Less	2,248	209	45	287	31	42	666	328	131	221	111	1,177
5,001 to 10,000	725	122	24	49	0	23	217	109	37	64	24	431
10,001 to 25,000	567	86	33	35	0	19	131	81	48	75	25	299
25,001 to 50,000	222	27	37	6	0	14	30	27	13	36	10	177
50,001 to 100,000	107	9	24	3	0	5	17	14	0	18	3	99
100,000 to 200,000	50	3	11	0	3	2	6	8	0	7	3	33
Over 200,000	29	1	3	0	4	1	4	7	0	4	2	22
Percent for Building Type												
5,000 or Less	56.9	45.7	25.4	75.5	50.8	39.6	62.2	57.0	55.5	52.0	62.0	63.0
5,001 to 10,000	18.4	26.7	13.6	12.9	0	21.7	20.3	19.0	15.7	15.1	13.4	15.3
10,001 to 25,000	14.4	18.8	18.6	9.2	0	17.9	12.2	14.1	20.3	17.6	14.0	10.3
25,001 to 50,000	5.6	5.9	20.9	1.6	0	13.2	2.8	4.7	5.5	8.5	5.6	6.0
50,001 to 100,000	2.7	2.0	13.6	0.8	0	4.7	1.6	2.4	0	4.2	1.7	3.2
100,000 to 200,000	1.3	0.7	6.2	0	4.9	1.9	0.6	1.4	0	1.6	1.7	1.1
Over 200,000	0.7	0.2	1.7	0	6.6	0.9	0.4	1.2	0	0.9	1.1	0.7
Total Square Footage												
5,000 or Less	4,908	485	113	636	80	95	1,433	749	325	448	176	368
5,001 to 10,000	5,246	901	182	343	0	166	1,562	803	265	446	186	314
10,001 to 25,000	8,912	1,390	560	568	0	310	2,013	1,236	748	1,202	405	410
25,001 to 50,000	7,692	912	1,322	209	0	495	1,065	976	432	1,203	350	528
50,001 to 100,000	7,168	621	1,619	179	0	318	1,089	933	0	1,198	214	614
100,000 to 200,000	6,642	412	1,449	0	433	303	800	1,086	0	937	441	467
Over 200,000	11,757	0	799	0	1,328	553	0	2,671	0	1,356	988	587
Percent for Building Type												
5,000 or Less	9.4	8.8	1.9	31.0	3.5	4.2	13.7	8.9	13.2	6.6	6.4	11.0
5,001 to 10,000	10.0	16.4	3.0	16.7	0	7.4	15.0	9.5	10.8	6.6	6.7	9.4
10,001 to 25,000	17.0	25.4	9.3	27.7	0	13.8	19.3	14.6	30.5	17.7	14.7	12.3
25,001 to 50,000	14.7	16.6	21.9	10.2	0	22.1	10.2	11.5	17.6	17.7	12.7	15.8
50,001 to 100,000	13.7	11.3	26.8	8.7	0	14.2	10.4	11.0	0	17.6	7.8	18.4
100,000 to 200,000	12.7	7.5	24.0	0	19.0	13.5	7.7	12.8	0	13.8	16.0	14.0
Over 200,000	22.5	0	13.2	0	58.3	24.7	0	31.6	0	20.0	35.4	17.6
Average Square Feet												
5,000 or Less	2.2	2.3	2.5	2.2	2.6	2.3	2.2	2.3	2.5	2.0	1.6	2.1
5,001 to 10,000	7.2	7.4	7.6	7.0	0	7.2	7.2	7.4	7.2	7.0	7.8	7.3
10,001 to 25,000	15.7	16.2	17.0	16.2	0	16.3	15.4	15.3	15.6	16.0	16.2	14.1
25,001 to 50,000	34.6	33.8	35.7	34.8	0	35.4	35.5	36.1	33.2	33.4	35.0	31.1
50,001 to 100,000	67.0	69.0	67.5	59.7	0	63.6	64.1	66.6	0	66.6	71.3	68.2
100,000 to 200,000	132.8	137.3	131.7	0	144.3	151.5	133.3	135.8	0	133.9	147.0	155.7
Over 200,000	405.4	0.0	266.3	0	332.0	553.0	0.0	381.6	0	339.0	494.0	293.5

MC = no cases in sample.

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Sources: Nonresidential Buildings Energy Consumption Surveys Characteristics of Commercial Buildings: 1983: U.S. DOE/EIA, July 1985.

TABLE 7.4 Fuel Usage and Conditioned Space in Commercial Building Types, 1983 (Thousands of Buildings)

FIGURE 7.4 Percentage of Heated Space in Heated Commercial Buildings

FIGURE 7.5 Percentage of Cooled Space in Cooled Commercial Buildings

Remarks:

1. Many buildings use more than one fuel. Therefore the sum of all building using each fuel is greater than the total number of buildings. When considering the extent to which buildings are heated or cooled, however, the various categories are mutually exclusive. Thus, for heating and cooling information in Table 7.4, the number of sum of buildings for each category does equal the total number of heated or cooled buildings.
2. Most of the buildings which do not use electricity and which are not heated at all tend to be warehouses, "other", or vacant. There is more diversity in buildings which are not cooled, where (with the exception of health care buildings, for which information is not available) all building types have sizeable numbers without air conditioning.

Building Categories	All Buildings	Assembly	Educational	Food Service & Sales	Health Care	Lodging	Mercantile & Services	Office	Residential	Warehouse	Other	Vacant
Number of Buildings												
1900 or Before	288	51	0	24	0	0	71	35	54	20	0	22
1901 to 1920	388	66	11	43	0	0	95	41	45	41	0	31
1921 to 1945	726	69	24	55	8	15	194	107	69	80	28	76
1946 to 1960	946	102	58	78	19	35	311	97	38	98	40	70
1961 to 1970	721	87	45	76	10	27	187	121	0	81	34	38
1971 to 1973	209	19	6	23	0	12	52	45	0	22	0	0
1974 to 1979	530	50	20	70	12	7	139	100	0	65	35	22
1980 to 1983	140	14	10	12	3	3	21	28	0	18	16	14
Percent of Building Type												
1900 or Before	7.3	11.2	0	6.3	0	0	6.6	6.1	22.9	4.7	0	7.8
1901 to 1920	9.8	14.4	6.2	11.3	0	0	8.9	7.1	19.1	9.6	0	11.0
1921 to 1945	18.4	15.1	13.6	14.5	13.1	14.2	18.1	18.6	29.2	18.8	15.6	27.0
1946 to 1960	24.0	22.3	32.8	20.5	31.1	33.0	29.0	16.9	16.1	23.1	22.3	24.9
1961 to 1970	18.3	19.0	25.4	20.0	16.4	25.5	17.5	21.0	0	19.1	19.0	13.5
1971 to 1973	5.3	4.2	3.4	6.1	0	11.3	4.9	7.8	0	5.2	0	0
1974 to 1979	13.4	10.9	11.3	18.4	19.7	6.6	13.0	17.4	0	15.3	19.6	7.8
1980 to 1983	3.5	3.1	5.6	3.2	4.9	2.8	2.0	4.9	0	4.2	8.9	5.0
Total Square Footage												
1900 or Before	2,940	373	0	129	0	0	488	429	609	-315	0	263
1901 to 1920	5,453	791	435	249	0	0	882	715	517	915	0	394
1921 to 1945	8,639	799	1,084	206	215	523	1,345	1,388	721	1,096	388	875
1946 to 1960	9,612	1,142	1,623	368	751	301	2,120	966	278	1,348	258	458
1961 to 1970	9,947	896	1,494	390	346	647	1,979	1,773	0	1,406	472	360
1971 to 1973	3,442	318	357	163	0	255	736	625	0	363	0	0
1974 to 1979	6,616	654	674	376	505	213	1,485	1,370	0	797	228	281
1980 to 1983	5,675	0	274	171	130	154	0	1,189	0	552	689	566
Percent of Square Footage												
1900 or Before	5.6	6.8	0	6.3	0	0	4.7	5.1	24.8	4.6	0	7.9
1901 to 1920	10.4	14.4	7.2	12.1	0	0	8.5	8.5	21.1	13.5	0	11.8
1921 to 1945	16.5	14.6	17.9	10.0	9.4	23.3	12.9	16.4	29.4	16.1	14.1	26.2
1946 to 1960	18.4	20.8	26.9	17.9	33.0	13.4	20.3	11.4	11.3	19.8	9.3	13.7
1961 to 1970	19.0	16.3	24.7	19.0	15.2	28.9	19.0	21.0	0	20.7	17.1	10.8
1971 to 1973	6.6	5.8	5.9	7.9	0	11.4	7.1	7.4	0	5.3	0	0
1974 to 1979	12.6	11.9	11.2	18.3	22.2	9.5	14.2	16.2	0	11.7	8.3	8.4
1980 to 1983	10.8	0	4.5	8.3	5.7	6.9	0	14.1	0	8.1	25.0	16.9
Average Square Footage												
1900 or Before	10.2	7.3	0	5.4	0	0	6.9	12.3	11.3	15.8	0	12.0
1901 to 1920	14.1	12.0	39.5	5.8	0	0	9.3	17.4	11.5	22.3	0	12.7
1921 to 1945	11.9	11.6	45.2	3.7	26.9	34.9	6.9	13.0	10.4	13.7	13.9	11.5
1946 to 1960	10.2	11.2	28.0	4.7	39.5	8.6	6.8	10.0	7.3	13.8	6.5	6.5
1961 to 1970	13.8	10.3	33.2	5.1	34.6	24.0	10.6	14.7	0	17.4	13.9	9.5
1971 to 1973	16.5	16.7	59.5	7.1	0	21.3	14.2	13.9	0	16.5	0	0
1974 to 1979	12.5	13.1	33.7	5.4	42.1	30.4	10.7	13.7	0	12.3	6.5	12.8
1980 to 1983	40.5	0.0	27.4	14.3	43.3	51.3	0.0	42.5	0	30.7	43.1	40.4

NC = no cases in sample.

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

TABLE 7.5 U.S. Commercial Buildings: Period of Construction by Amount of Floor Space, as of 1983 (Thousands of Buildings)

Remarks:

1. Of the commercial buildings existing in the U.S. at the time of the 1983 Non-residential Building Energy Consumption Survey, there were not large disparities between most of the earlier and later periods with regard to percentage distribution of commercial buildings according to size. If it is true that, in the more recent periods, proportionately more large-sized commercial buildings have been constructed than in the earlier periods, then this table suggests that the larger old commercial buildings last longer than the smaller ones, thus increasing their proportion within their period over time.

Building Categories	Number of All Buildings	% of U.S. Total	Northeast	% of Regional Total	North Central	% of Regional Total	South	% of Regional Total	West	% of Regional Total
Number of All Buildings (1)	3,948	100.0	670	17.0	1,211	30.7	1,493	37.8	574	14.5
Total Square Footage (1)	52,325	100.0	11,615	22.2	16,059	30.7	17,049	32.6	7,602	14.5
Period of Construction:										
Number of Buildings										
1900 or Before	288	7.3	102	15.2	110	9.1	49	3.3	27	4.7
1901 to 1920	388	9.8	93	13.9	158	13.0	100	6.7	37	6.4
1921 to 1945	726	18.4	160	23.9	225	18.6	227	15.2	114	19.9
1946 to 1960	946	24.0	131	19.6	275	22.7	396	26.5	144	25.1
1961 to 1970	721	18.3	94	14.0	189	15.6	345	23.1	94	16.4
1971 to 1973	209	5.3	26	3.9	59	4.9	90	6.0	35	6.1
1974 to 1979	530	13.4	50	7.5	162	13.4	224	15.0	95	16.6
1980 to 1983	140	3.5	14	2.1	33	2.7	64	4.3	29	5.1
Total Square Footage										
1900 or Before	2,940	5.6	1,289	11.1	1,123	7.0	355	2.1	Q	Q
1901 to 1920	5,453	10.4	1,850	15.9	1,879	11.7	1,173	6.9	550	7.2
1921 to 1945	8,639	16.5	2,398	20.6	2,795	17.4	2,221	13.0	1,225	16.1
1946 to 1960	9,612	18.4	2,083	17.9	3,128	19.5	3,258	19.1	1,143	15.0
1961 to 1970	9,947	19.0	1,798	15.5	3,043	18.9	3,594	21.1	1,512	19.9
1971 to 1973	3,442	6.6	651	5.6	953	5.9	1,296	7.6	542	7.1
1974 to 1979	6,616	12.6	720	6.2	2,166	13.5	2,487	14.6	1,244	16.4
1980 to 1983	5,675	10.8	826	7.1	972	6.1	2,665	15.6	Q	Q
Building Size Categories:										
Number of Buildings										
5,000 or Less	2,248	56.9	306	45.7	688	56.8	955	64.0	299	52.1
5,001 to 10,000	725	18.4	131	19.6	234	19.3	236	15.8	124	21.6
10,001 to 25,000	567	14.4	130	19.4	163	13.5	185	12.4	89	15.5
25,001 to 50,000	222	5.6	58	8.7	68	5.6	60	4.0	37	6.4
50,001 to 100,000	107	2.7	27	4.0	31	2.6	32	2.1	17	3.0
100,001 to 200,000	50	1.3	12	1.8	16	1.3	15	1.0	6	1.0
Over 200,000	29	0.7	6	0.9	11	0.9	9	0.6	3	0.5
Total Square Footage										
5,000 or Less	4,908	9.4	784	6.7	1,526	9.5	1,971	11.6	627	8.2
5,001 to 10,000	5,246	10.0	939	8.1	1,685	10.5	1,685	9.9	937	12.3
10,001 to 25,000	8,912	17.0	1,960	16.9	2,616	16.3	2,923	17.1	1,412	18.6
25,001 to 50,000	7,692	14.7	1,915	16.5	2,334	14.5	2,176	12.8	1,267	16.7
50,001 to 100,000	7,168	13.7	1,754	15.1	2,146	13.4	2,199	12.9	1,068	14.0
100,001 to 200,000	6,642	12.7	1,598	13.8	2,132	13.3	2,069	12.1	843	11.1
Over 200,000	11,757	22.5	2,666	23.0	3,618	22.5	4,025	23.6	Q	Q

Q = Data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

(1) Percentages shown in this row present regional share of U.S. total.

TABLE 7.6 The Age and Area of Commercial Buildings in the U.S., by Region, 1983
(Thousands of Buildings, Millions of Square Feet)

Remarks:

1. Not surprisingly, the Northeast and North Central Regions have proportionately more older commercial buildings than do the South and the West, while these latter regions, which have been experiencing higher rates of growth more recently, have proportionately more new commercial buildings.
2. Fifteen percent of all Northeast buildings have over 25,000 square feet, the highest percentage of all regions. The South has the lowest percentage of regions with 8%.

7.2 SPACE HEATING FUEL USAGE IN U.S. COMMERCIAL BUILDINGS

Building Categories	Number of All Buildings	All Buildings That Provide Heat	Electricity	Natural Gas	Fuel Oil	Other Fuels (1)
All Buildings	3,948	3,507	1,105	2,011	566	417
Year Constructed						
1900 or Before	288	268	41	177	76	76
1901 to 1920	388	355	71	236	76	81
1921 to 1945	726	633	146	414	128	144
1946 to 1960	946	813	214	467	147	210
1961 to 1970	721	649	248	361	73	101
1971 to 1973	209	199	81	94	26	26
1974 to 1979	530	466	242	197	36	65
1980 to 1983	140	125	62	64	3	6
Square Footage Category						
5,000 or Less	2,248	1,903	589	1,020	287	216
5,001 to 10,000	725	680	217	433	114	Q
10,001 to 25,000	567	541	187	322	99	13
25,001 to 50,000	222	207	60	131	33	11
50,001 to 100,000	107	101	29	59	17	8
100,001 to 200,000	50	47	15	30	10	5
Over 200,000	29	28	8	15	6	6
Principal Activity Within Building						
Assembly	457	443	138	245	89	38
Educational	177	177	52	102	34	16
Food Sales/Service	380	367	121	204	42	Q
Health Care	61	61	18	33	7	Q
Lodging	106	102	54	43	13	8
Mercantile/Services	1,071	982	244	603	182	108
Office	575	566	231	309	65	11
Residential	236	235	49	152	53	Q
Warehouse	425	299	104	173	45	13
Other	179	140	50	60	18	6
Vacant	281	136	44	87	Q	4
Census Region						
Northeast	670	627	116	348	241	28
North Central	1,211	1,113	203	854	105	109
South	1,493	1,279	604	527	179	147
West	574	489	183	281	41	9
Percent Heated						
Not Heated	440	0	0	0	0	0
1% to 50%	517	517	174	285	80	27
51% to 99%	564	564	189	328	93	17
100%	2,427	2,426	742	1,398	393	269

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.
(1) The category "Other Fuels" is comprised of the following particular fuel types:

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983: U.S. DOE/EIA, July 1985.

TABLE 7.7 Space Heating Fuel Usage in Commercial Buildings, 1983
(Thousands of Buildings)

Building Categories	Percent of All Buildings	All Buildings That Provide Heat	Electricity	Natural Gas	Fuel Oil	Other Fuels (1)
All Buildings	100.0	88.8	31.5	57.3	16.1	11.9
Year Constructed						
1900 or Before	7.3	93.1	15.3	66.0	28.4	28.4
1901 to 1920	9.8	91.5	20.0	66.5	21.4	22.8
1921 to 1945	18.4	87.2	23.1	65.4	20.2	22.7
1946 to 1960	24.0	85.9	26.3	57.4	18.1	25.8
1961 to 1970	18.3	90.0	38.2	55.6	11.2	15.6
1971 to 1973	5.3	95.2	40.7	47.2	13.1	13.1
1974 to 1979	13.4	87.9	51.9	42.3	7.7	13.9
1980 to 1983	3.5	89.3	49.6	51.2	2.4	4.8
Square Footage Category						
5,000 or Less	56.9	84.7	31.0	53.6	15.1	11.4
5,001 to 10,000	18.4	93.8	31.9	63.7	16.8	Q
10,001 to 25,000	14.4	95.4	34.6	59.5	18.3	2.4
25,001 to 50,000	5.6	93.2	29.0	63.3	15.9	5.3
50,001 to 100,000	2.7	94.4	28.7	58.4	16.8	7.9
100,001 to 200,000	1.3	94.0	31.9	63.8	21.3	10.6
Over 200,000	0.7	96.6	28.6	53.6	21.4	21.4
Principal Activity Within Building						
Assembly	11.6	96.9	31.2	55.3	20.1	8.6
Educational	4.5	100.0	29.4	57.6	19.2	9.0
Food Sales/Service	9.6	96.6	33.0	55.6	11.4	Q
Health Care	1.5	100.0	29.5	54.1	11.5	Q
Lodging	2.7	96.2	52.9	42.2	12.7	7.8
Mercantile/Services	27.1	91.7	24.8	61.4	18.5	11.0
Office	14.6	98.4	40.8	54.6	11.5	1.9
Residential	6.0	99.6	20.9	64.7	22.6	Q
Warehouse	10.8	70.4	34.8	57.9	15.1	4.3
Other	4.5	78.2	35.7	42.9	12.9	4.3
Vacant	7.1	48.4	32.4	64.0	Q	2.9
Census Region						
Northeast	17.0	93.6	18.5	55.5	38.4	4.5
North Central	30.7	91.9	18.2	76.7	9.4	9.8
South	37.8	85.7	47.2	41.2	14.0	11.5
West	14.5	85.2	37.4	57.5	8.4	1.8
Percent Heated						
Not Heated	11.1	0.0	0.0	0.0	0.0	0.0
1% to 50%	13.1	100.0	33.7	55.1	15.5	5.2
51% to 99%	14.3	100.0	33.5	58.2	16.5	3.0
100%	61.5	100.0	30.6	57.6	16.2	11.1

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.
(1) The category "Other Fuels" is comprised of the following particular fuel types:

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983. U.S. DOE/EIA, July 1985.

TABLE 7.8 Space Heating Fuel Usage in Commercial Buildings, 1983
(Percentage Distributions)

FIGURE 7.6 Space Heating Fuel Usage in Commercial Buildings
Percentage of All Heated Buildings

FIGURE 7.7 Space Heating Fuel Usage in Commercial Buildings, by Region

Remarks:

1. Over half of all commercial buildings in the U.S. use natural gas for space heating. Natural gas is most popular in the North Central region, where 77% of all commercial buildings use it. It is least common in the South, where only 41% of the commercial buildings use it. Natural gas is more frequently used in older buildings, although the most recent period (1980 - 1983) showed a marked increase in use.
2. Electricity is used as for space heating in 32% of the commercial buildings in the U.S., making it the second most popular space heating fuel. It is most popular in the South and West; least popular in the Northeast and North Central Regions. The incidence of electricity increases with the newness of the buildings, going from an incidence of only 15% for buildings built before 1900 to 52% in the period of 1974 through 1979. There has been a slight falling off in the incidence of electricity in the most recent period.
3. Fuel oil is used as a space heating fuel in 16% of the U.S. commercial buildings, making it the third most popular fuel. As in the residential sector, fuel oil is most popular in the Northeast Region, where 38% of the buildings use it. It is least popular in the North Central and Western Regions, where 9% and 8% use it, respectively. Surprisingly, 14% of the commercial buildings in the South use fuel oil. Like natural gas, fuel oil is more commonly used in older buildings. Its use declines precipitously in more recently constructed buildings.

7.3 HEATING SYSTEMS USED IN U.S. COMMERCIAL BUILDINGS, 1983

Building Categories	Number of All Buildings	All Buildings That Provide Heat	Self-Contained Units Only	Central Systems Only or in Combination with Self-Contained Units		Heat Pumps
				Total	Furnace or Boiler	
All Buildings	3,948	3,508	583	2,904	2,190	169
Year Constructed						
1900 or Before	288	268	22	245	222	Q
1901 to 1920	388	355	49	306	275	Q
1921 to 1945	726	633	116	512	416	Q
1946 to 1960	946	813	159	648	499	26
1961 to 1970	721	649	101	543	381	53
1971 to 1973	209	199	24	176	118	Q
1974 to 1979	530	466	98	366	223	41
1980 to 1983	140	125	15	109	56	19
Square Footage Category						
5,000 or Less	2,248	1,903	385	1,504	1,108	100
5,001 to 10,000	725	680	94	581	449	35
10,001 to 25,000	567	541	65	476	368	18
25,001 to 50,000	222	207	24	183	142	9
50,001 to 100,000	107	101	9	91	69	3
100,001 to 200,000	50	47	6	42	33	2
Over 200,000	29	28	1	27	19	Q
Principal Activity Within Building						
Assembly	457	443	37	405	334	24
Educational	177	177	22	153	131	7
Food Sales/Service	380	367	61	303	214	Q
Health Care	61	61	Q	54	39	Q
Lodging	106	102	29	73	51	Q
Mercantile/Services	1,071	982	232	739	546	26
Office	575	566	50	512	358	45
Residential	236	235	23	213	187	Q
Warehouse	425	299	66	233	161	Q
Other	179	140	30	110	79	Q
Vacant	281	136	28	109	89	Q
Census Region						
Northeast	670	627	66	560	485	6
North Central	1,211	1,113	107	1,002	893	15
South	1,493	1,279	312	955	547	119
West	574	489	98	388	265	29
Percent Heated						
Not Heated	440	0	0	0	0	0
1% to 50%	517	517	148	364	273	22
51% to 99%	564	564	76	484	365	31
100%	2,427	2,426	360	2,056	1,552	116

Q = Data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983: U.S. DOE/EIA, July 1985.

TABLE 7.9 Heating Systems Used In Commercial Buildings, 1983
(Thousands of Buildings)

Percent of All Buildings that Provide Heat

Building Categories	Number of All Buildings	All Buildings That Provide Heat	Self-Contained Units Only	Central Systems Only or in Combination with Self-Contained Units		
				Total	Furnace or Boiler	Heat Pumps
All Buildings	100.0	88.9	16.6	82.8	62.4	4.8
Year Constructed						
1900 or Before	7.3	93.1	8.2	91.4	82.8	Q
1901 to 1920	9.8	91.5	13.8	86.2	77.5	Q
1921 to 1945	18.4	87.2	18.3	80.9	65.7	Q
1946 to 1960	24.0	85.9	19.6	79.7	61.4	3.2
1961 to 1970	18.3	90.0	15.6	83.7	58.7	8.2
1971 to 1973	5.3	95.2	12.1	88.4	59.3	Q
1974 to 1979	13.4	87.9	21.0	78.5	47.9	8.8
1980 to 1983	3.5	89.3	12.0	87.2	44.8	15.2
Square Footage Category						
5,000 or Less	56.9	84.7	20.2	79.0	58.2	5.3
5,001 to 10,000	18.4	93.8	13.8	85.4	66.0	5.1
10,001 to 25,000	14.4	95.4	12.0	88.0	68.0	3.3
25,001 to 50,000	5.6	93.2	11.6	88.4	68.6	4.3
50,001 to 100,000	2.7	94.4	8.9	90.1	68.3	3.0
100,001 to 200,000	1.3	94.0	12.8	89.4	70.2	4.3
Over 200,000	0.7	96.6	3.6	96.4	67.9	Q
Principal Activity Within Building						
Assembly	11.6	96.9	8.4	91.4	75.4	5.4
Educational	4.5	100.0	12.4	86.4	74.0	4.0
Food Sales/Service	9.6	96.6	16.6	82.6	58.3	Q
Health Care	1.5	100.0	Q	88.5	63.9	Q
Lodging	2.7	96.2	28.4	71.6	50.0	Q
Mercantile/Services	27.1	91.7	23.6	75.3	55.6	2.6
Office	14.6	98.4	8.8	90.5	63.3	8.0
Residential	6.0	99.6	9.8	90.6	79.6	Q
Warehouse	10.8	70.4	22.1	77.9	53.8	Q
Other	4.5	78.2	21.4	78.6	56.4	Q
Vacant	7.1	48.4	20.6	80.1	65.4	Q
Census Region						
Northeast	17.0	93.6	10.5	89.3	77.4	1.0
North Central	30.7	91.9	9.6	90.0	80.2	1.3
South	37.8	85.7	24.4	74.7	42.8	9.3
West	14.5	85.2	20.0	79.3	54.2	5.9
Percent Heated						
Not Heated	11.1	0.0	0.0	0.0	0.0	0.0
1% to 50%	13.1	100.0	28.6	70.4	52.8	4.3
51% to 99%	14.3	100.0	13.5	85.8	64.7	5.5
100%	61.5	100.0	14.8	84.7	64.0	4.8

Q = Data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983. U.S. DOE/EIA, July 1985.

Source: Table 7.9

TABLE 7.10 Heating Systems Used In Commercial Buildings, 1983
(Percentages for Number of Buildings)

FIGURE 7.8 Heating System Types Used In Commercial Buildings, 1983

FIGURE 7.9 Heating System Types in Commercial Buildings, by Region, 1983

Remarks:

1. "Self-Contained Heating Units" are units installed in either the building or the roof and which generate and deliver heat only to a local zone within the building. "Central Heating Systems" have a centrally located heating plant, such as a furnace/boiler or an electric resistance unit, which produces heated water or hot air for distribution throughout the heated portion of the building.
2. Heat pumps are considered separately from both self-contained units and central systems. They may be used for heating either a local zone, like the self-contained units, or the entire conditioned area of the building, like the central systems. They may also be used to simultaneously heat and cool different areas of the same building. The EIA reports that the number of heat pumps estimated in their report is a conservative estimate because counts were obtained from open-ended questions about heating and heat distribution systems, such as heat pumps, which were not specifically mentioned in the survey questionnaire.
3. Central heating systems are the most frequently found type of heating system in commercial buildings in the U.S. They are most popular in the Northeast and North Central Regions; somewhat less popular in the South and West. The smallest sized commercial buildings are the least likely to have central systems but even for these buildings, 79% have central systems.

7.4 HEAT DISTRIBUTION SYSTEMS USED IN U.S. COMMERCIAL BUILDINGS, 1983

Building Categories	Number of All Buildings	All Buildings That Provide Heat	Heating System Types					Other
			Air Forced Through Ducts	Baseboards		Hot Water or Steam	Radiators, Convectors, or Heating Panels	
				All Buildings	Electric			
All Buildings	3,948	3,508	1,858	538	290	265	59	401
Year Constructed								
1900 or Before	288	268	120	52	20	33	Q	29
1901 to 1920	388	355	165	47	23	25	9	22
1921 to 1945	726	633	239	88	45	37	10	78
1946 to 1960	946	813	414	110	52	64	18	94
1961 to 1970	721	649	406	118	59	62	10	85
1971 to 1973	209	199	131	34	25	Q	Q	32
1974 to 1979	530	466	287	72	57	17	4	45
1980 to 1983	140	125	96	17	9	8	2	15
Square Footage Category								
5,000 or Less	2,248	1,903	928	231	140	86	29	244
5,001 to 10,000	725	680	384	124	68	51	Q	69
10,001 to 25,000	567	541	319	95	52	45	13	53
25,001 to 50,000	222	207	120	47	16	28	5	17
50,001 to 100,000	107	101	59	23	8	16	3	8
100,001 to 200,000	50	47	27	12	4	8	3	7
Over 200,000	29	28	21	8	3	7	2	3
Principal Activity Within Building								
Assembly	457	443	287	89	51	31	Q	49
Educational	177	177	87	39	10	32	9	13
Food Sales/Service	380	367	199	37	30	Q	Q	55
Health Care	61	61	37	15	Q	14	1	Q
Lodging	106	102	30	25	14	12	Q	15
Mercantile/Services	1,071	982	464	81	44	31	Q	128
Office	575	566	389	112	66	51	10	55
Residential	236	235	86	45	19	25	Q	Q
Warehouse	425	299	150	56	32	23	Q	47
Other	179	140	59	23	15	Q	Q	13
Vacant	281	136	71	15	6	7	Q	13
Census Region								
Northeast	670	627	251	167	69	108	13	53
North Central	1,211	1,113	677	211	88	127	26	84
South	1,493	1,279	670	86	72	16	15	215
West	574	489	260	74	60	Q	Q	50
Fuel Used For Heating								
Electricity	1,105	1,105	590	253	222	44	16	161
Natural Gas	2,011	2,011	1,140	279	115	170	36	190
Fuel Oil	566	566	290	122	45	82	16	44
Propane	161	161	59	Q	Q	Q	Q	39
Purchased Steam	55	55	26	22	Q	21	5	3
Other	170	170	49	25	21	Q	Q	43

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983.
U.S. DOE/EIA, July 1985.

TABLE 7.11 Heat Distribution Systems Used In U.S. Commercial Buildings, 1983
(Thousands of Buildings)

Building Categories	Percent of All Buildings	All Buildings That Provide Heat	Heating System Types					Radiators, Convectors, or Heating Panels	Other
			Air Forced Through Ducts	Baseboards					
				All Buildings	Electric	Hot Water or Steam			
All Buildings	100.0	88.9	53.0	15.3	8.3	7.6	1.7	11.4	
Year Constructed									
1900 or Before	7.3	93.1	44.8	19.4	7.5	12.3	Q	10.8	
1901 to 1920	9.8	91.5	46.5	13.2	6.5	7.0	2.5	6.2	
1921 to 1945	18.4	87.2	37.8	13.9	7.1	5.8	1.6	12.3	
1946 to 1960	24.0	85.9	50.9	13.5	6.4	7.9	2.2	11.6	
1961 to 1970	18.3	90.0	62.6	18.2	9.1	9.6	1.5	13.1	
1971 to 1973	5.3	95.2	65.8	17.1	12.6	Q	Q	16.1	
1974 to 1979	13.4	87.9	61.6	15.5	12.2	3.6	0.9	9.7	
1980 to 1983	3.5	89.3	76.8	13.6	7.2	6.4	1.6	12.0	
Square Footage Category									
5,000 or Less	56.9	84.7	48.8	12.1	7.4	4.5	1.5	12.8	
5,001 to 10,000	18.4	93.8	56.5	18.2	10.0	7.5	Q	10.1	
10,001 to 25,000	14.4	95.4	59.0	17.6	9.6	8.3	2.4	9.8	
25,001 to 50,000	5.6	93.2	58.0	22.7	7.7	13.5	2.4	8.2	
50,001 to 100,000	2.7	94.4	58.4	22.8	7.9	15.8	3.0	7.9	
100,001 to 200,000	1.3	94.0	57.4	25.5	8.5	17.0	6.4	14.9	
Over 200,000	0.7	96.6	75.0	28.6	10.7	25.0	7.1	10.7	
Principal Activity Within Building									
Assembly	11.6	96.9	64.8	20.1	11.5	7.0	Q	11.1	
Educational	4.5	100.0	49.2	22.0	3.6	18.1	5.1	7.3	
Food Sales/Service	9.6	96.6	54.2	10.1	6.2	Q	Q	15.0	
Health Care	1.5	100.0	60.7	24.6	Q	23.0	1.6	Q	
Lodging	2.7	96.2	29.4	24.5	13.7	11.8	Q	14.7	
Mercantile/Services	27.1	91.7	47.3	8.2	4.5	3.2	Q	13.0	
Office	14.6	98.4	68.7	19.8	11.7	9.0	1.8	9.7	
Residential	6.0	99.6	36.6	19.1	8.1	10.6	Q	Q	
Warehouse	10.8	70.4	50.2	18.7	10.7	7.7	Q	15.7	
Other	4.5	78.2	42.1	16.4	10.7	Q	Q	9.3	
Vacant	7.1	48.4	52.2	11.0	4.4	5.1	Q	9.6	
Census Region									
Northeast	17.0	93.6	40.0	26.6	11.0	17.2	2.1	8.5	
North Central	30.7	91.9	60.8	19.0	7.9	11.4	2.3	7.5	
South	37.8	85.7	52.4	6.7	5.6	1.3	1.2	16.8	
West	14.5	85.2	53.2	15.1	12.3	Q	Q	10.2	
Fuel Used For Heating									
Electricity	28.0	100.0	53.4	22.9	20.1	4.0	1.4	14.6	
Natural Gas	50.9	100.0	56.7	13.9	5.7	8.5	1.8	9.4	
Fuel Oil	14.3	100.0	51.2	21.6	8.0	14.5	2.8	7.8	
Propane	4.1	100.0	36.6	Q	Q	Q	Q	24.2	
Purchased Steam	1.4	100.0	47.3	40.0	Q	38.2	9.1	5.5	
Other	4.3	100.0	28.8	14.7	12.4	Q	Q	25.3	

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983.
U.S. DOE/EIA, July 1985.

Source: Table 4.11

TABLE 7.12 Heat Distribution Systems Used In U.S. Commercial Buildings, 1983
(Percentages for Number of Buildings)

FIGURE 7.10 Heat Distribution Systems in Commercial Buildings, 1983

FIGURE 7.11 Heat Distribution Systems in Commercial Buildings, by Region, 1983

Remarks:

1. Heat distribution systems are not used with self-contained heating systems but only with central systems. The sum of the total number of buildings with some kind of heat distribution system (2,856,000) therefore does not equal the sum of all buildings which provide heat (3,508,000). It does approximately equal the sum of all buildings which have central heating systems, however (2,904,000).
2. Warm air heating ducts are used in over half of all commercial buildings in the U.S. Duct-based distribution systems are most common in the North Central Region; least in the Northeast. They are least common in the older buildings, in the smallest category of commercial building, and in lodging buildings. They most common in the newest buildings, in the largest buildings, and in office and assembly buildings.

7.5 COOLING FUELS AND SYSTEMS IN U.S. COMMERCIAL BUILDINGS

Building Categories	Number of All Buildings	All Buildings With Cooling	Fuels Used For Cooling		Cooling Equipment			
			Electricity	Natural Gas	Window Units	Wall Units	Central Air Conditioning	Heat Pumps
All Buildings	3,948	2,643	2,515	141	812	406	1,748	169
Year Constructed								
1900 or Before	288	175	166	Q	87	29	86	Q
1901 to 1920	388	247	241	Q	77	39	155	Q
1921 to 1945	726	433	413	26	226	66	224	Q
1946 to 1960	946	599	564	37	241	115	339	26
1961 to 1970	721	530	506	29	100	83	392	53
1971 to 1973	209	150	143	7	22	19	121	Q
1974 to 1979	530	394	377	18	54	44	329	41
1980 to 1983	140	113	104	8	5	11	102	19
Square Footage Category								
5,000 or Less	2,248	1,345	1,282	74	452	222	785	100
5,001 to 10,000	725	521	499	27	148	77	371	35
10,001 to 25,000	567	443	424	18	116	61	334	18
25,001 to 50,000	222	178	166	12	50	26	128	9
50,001 to 100,000	107	88	81	7	28	9	70	3
100,001 to 200,000	50	41	39	2	12	7	35	2
Over 200,000	29	27	24	2	6	4	25	Q
Principal Activity Within Building								
Assembly	457	296	282	Q	80	31	227	24
Educational	177	130	123	7	52	19	82	7
Food Sales/Service	380	314	303	20	69	48	221	Q
Health Care	61	55	53	1	9	13	42	Q
Lodging	106	79	77	Q	30	30	37	Q
Mercantile/Services	1,071	659	640	26	227	104	377	26
Office	575	525	488	42	109	49	428	45
Residential	236	163	154	Q	96	46	62	Q
Warehouse	425	230	208	19	69	39	152	Q
Other	179	98	97	Q	34	12	64	Q
Vacant	281	94	89	Q	37	Q	57	Q
Census Region								
Northeast	670	444	417	26	206	98	227	6
North Central	1,211	804	755	51	228	99	560	15
South	1,493	1,111	1,079	32	327	180	755	119
West	574	284	264	31	51	28	206	29

Q = data withheld because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983. U.S. DOE/EIA, July 1985.

TABLE 7.13 Cooling Fuels and Systems for Commercial Buildings, 1983
(Thousands of Buildings)

Building Categories	Percent of All Buildings	All Buildings With Cooling	Fuels Used For Cooling		Cooling Equipment			
			Electricity	Natural Gas	Window Units	Wall Units	Central Air Conditioning	Heat Pumps
All Buildings	100.0	66.9	95.2	5.3	30.7	15.4	66.1	6.4
Year Constructed								
1900 or Before	7.3	60.8	94.9	Q	49.7	16.6	49.1	Q
1901 to 1920	9.8	63.7	97.6	Q	31.2	15.8	62.8	Q
1921 to 1945	18.4	59.6	95.4	6.0	52.2	15.2	51.7	Q
1946 to 1960	24.0	63.3	94.2	6.2	40.2	19.2	56.6	4.3
1961 to 1970	18.3	73.5	95.5	5.5	18.9	15.7	74.0	10.0
1971 to 1973	5.3	71.8	95.3	4.7	14.7	12.7	80.7	Q
1974 to 1979	13.4	74.3	95.7	4.6	13.7	11.2	83.5	10.4
1980 to 1983	3.5	80.7	92.0	7.1	4.4	9.7	90.3	16.8
Square Footage Category								
5,000 or Less	56.9	59.8	95.3	5.5	33.6	16.5	58.4	7.4
5,001 to 10,000	18.4	71.9	95.8	5.2	28.4	14.8	71.2	6.7
10,001 to 25,000	14.4	78.1	95.7	4.1	26.2	13.8	75.4	4.1
25,001 to 50,000	5.6	80.2	93.3	6.7	28.1	14.6	71.9	5.1
50,001 to 100,000	2.7	82.2	92.0	8.0	31.8	10.2	79.5	3.4
100,001 to 200,000	1.3	82.0	95.1	4.9	29.3	17.1	85.4	4.9
Over 200,000	0.7	93.1	88.9	7.4	22.2	14.8	92.6	Q
Principal Activity Within Building								
Assembly	11.6	64.8	95.3	Q	27.0	10.5	76.7	8.1
Educational	4.5	73.4	94.6	5.4	40.0	14.6	63.1	5.4
Food Sales/Service	9.6	82.6	96.5	6.4	22.0	15.3	70.4	Q
Health Care	1.5	90.2	96.4	1.8	16.4	23.6	76.4	Q
Lodging	2.7	74.5	97.5	Q	38.0	38.0	46.8	Q
Mercantile/Services	27.1	61.5	97.1	3.9	34.4	15.8	57.2	3.9
Office	14.6	91.3	93.0	8.0	20.8	9.3	81.5	8.6
Residential	6.0	69.1	94.5	Q	58.9	28.2	38.0	Q
Warehouse	10.8	54.1	90.4	8.3	30.0	17.0	66.1	Q
Other	4.5	54.7	99.0	Q	34.7	12.2	65.3	Q
Vacant	7.1	33.5	94.7	Q	39.4	0	60.6	Q
Census Region								
Northeast	17.0	66.3	93.9	5.9	46.4	22.1	51.1	1.4
North Central	30.7	66.4	93.9	6.3	28.4	12.3	69.7	1.9
South	37.8	74.4	97.1	2.9	29.4	16.2	68.0	10.7
West	14.5	49.5	93.0	10.9	18.0	9.9	72.5	10.2

Q = data withheld because RSE was greater than 50%, or fewer than 20 buildings were sampled.

Source: Nonresidential Buildings Energy Consumption Surveys: Characteristics of Commercial Buildings: 1983.
U.S. DOE/EIA, July 1985.

Source: Table 7.13

TABLE 7.14 Cooling Fuels and Systems in Commercial Buildings, 1983
(Percentages for Number of Buildings)

FIGURE 7.12 Air Conditioning Equipment Types in Commercial Buildings, 1983

FIGURE 7.13 Air Conditioning Equipment in Commercial Buildings, by Region, 1983

Remarks:

1. Only air conditioning and heat pump technologies are included in Tables 7.13 and 7.14 and their associated figures, which portray cooling fuels and equipment used in U.S. commercial buildings. Not included are cooling technologies which solely make use of fans, blowers, or evaporative cooling systems which are not connected to a refrigeration unit. Air conditioning units not in working order at the time of the survey are included in the data.
2. Central air conditioning is the most common type of air conditioning equipment in commercial buildings. It most frequently found in newer and larger buildings and in buildings in regions other than the Northeast. Window and wall units are more frequently found in older and smaller buildings and are much more common in the Northeast than elsewhere. Heat pumps are most popular in the South and West and in newer buildings.

7.6 ENERGY CONSERVATION IN U.S. COMMERCIAL BUILDINGS, AS OF 1983

Building Categories	Number of All Buildings	Buildings with Heating or Cooling	Insulated Glass	Roof/Ceiling Insulation	Wall Insulation	Computerized Control of Heating/Cooling System	Professional Energy Audit	Measures Taken in Response to Audit
All Buildings	3,948	3,556	2,726	1,904	1,366	105	434	187
Year Constructed								
1900 or Before	288	268	196	127	87	Q	23	12
1901 to 1920	388	360	216	135	100	9	37	18
1921 to 1945	726	639	441	294	176	10	73	35
1946 to 1960	946	833	573	423	272	23	83	45
1961 to 1970	721	656	548	388	262	19	94	35
1971 to 1973	209	201	171	120	96	9	38	15
1974 to 1979	530	473	450	312	267	22	65	19
1980 to 1983	140	128	130	106	106	12	22	8
Square Footage Category								
5,000 or Less	2,248	1,940	1,450	1,029	752	29	151	52
5,001 to 10,000	725	684	545	354	263	Q	96	43
10,001 to 25,000	567	544	421	297	219	20	75	38
25,001 to 50,000	222	211	163	116	70	15	58	27
50,001 to 100,000	107	101	84	62	35	13	25	12
100,001 to 200,000	50	47	37	27	15	10	18	9
Over 200,000	29	28	25	19	12	7	11	5
Principal Activity Within Building								
Assembly	457	444	359	246	162	12	52	24
Educational	177	177	136	98	58	17	49	24
Food Sales/Service	380	375	280	186	153	13	44	15
Health Care	61	61	55	46	34	3	18	Q
Lodging	106	104	77	61	43	8	24	11
Mercantile/Services	1,071	1,010	665	479	290	15	85	36
Office	575	567	488	333	274	25	88	39
Residential	236	235	171	111	89	Q	20	Q
Warehouse	425	310	223	153	112	2	30	14
Other	179	138	110	73	63	4	19	Q
Vacant	281	137	162	118	89	3	6	3
Census Region								
Northeast	670	628	464	310	233	24	81	45
North Central	1,211	1,115	867	601	452	36	120	54
South	1,493	1,317	1,001	712	478	27	154	58
West	574	496	395	282	203	18	78	30
Fuel Used For Heating								
Electricity	1,105	1,099	873	642	517	39	NA	NA
Natural Gas	2,011	2,010	1,463	987	718	58	NA	NA
Fuel Oil	566	566	388	278	166	12	NA	NA
Propane	161	160	112	79	69	Q	NA	NA
Purchased Steam	55	55	41	35	12	9	NA	NA
Other	170	168	102	85	67	2	NA	NA

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.
NA = Information was not available.

Note: Columns do not sum to the total for heated and/or cooled buildings.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983: U.S. DOE/EIA, July 1985.

TABLE 7.15 Energy Conservation In Commercial Buildings, 1983
(Thousands of Buildings)

Building Categories	Percentage of Buildings in Each Category with Heating or Cooling							% of Audited Buildings
	Percent of All Buildings	% of Building Category Buildings With Heating or Cooling	Insulated Glass	Roof/Ceiling Insulation	Wall Insulation	Computerized Control of Heating/Cooling System	Professional Energy Audit	
All Buildings	100.0	90.1	76.7	53.5	38.4	3.0	12.2	43.1
Year Constructed								
1900 or Before	7.3	93.1	73.1	47.4	32.5	Q	8.6	52.2
1901 to 1920	9.8	92.8	60.0	37.5	27.8	2.5	10.3	48.6
1921 to 1945	18.4	88.0	69.0	46.0	27.5	1.6	11.4	47.9
1946 to 1960	24.0	88.1	68.8	50.8	32.7	2.8	10.0	54.2
1961 to 1970	18.3	91.0	83.5	59.1	39.9	2.9	14.3	37.2
1971 to 1973	5.3	96.2	85.1	59.7	47.8	4.5	18.9	39.5
1974 to 1979	13.4	89.2	95.1	66.0	56.4	4.7	13.7	29.2
1980 to 1983	3.5	91.4	101.6	82.8	82.8	9.4	17.2	36.4
Square Footage Category								
5,000 or Less	56.9	86.3	74.7	53.0	38.8	1.5	7.8	34.4
5,001 to 10,000	18.4	94.3	79.7	51.8	38.5	Q	14.0	44.8
10,001 to 25,000	14.4	95.9	77.4	54.6	40.3	3.7	13.8	50.7
25,001 to 50,000	5.6	95.0	77.3	55.0	33.2	7.1	27.5	46.6
50,001 to 100,000	2.7	94.4	83.2	61.4	34.7	12.9	24.8	48.0
100,001 to 200,000	1.3	94.0	78.7	57.4	31.9	21.3	38.3	50.0
Over 200,000	0.7	96.6	89.3	67.9	42.9	25.0	39.3	45.5
Principal Activity Within Building								
Assembly	11.6	97.2	80.9	55.4	36.5	2.7	11.7	46.2
Educational	4.5	100.0	76.8	55.4	32.8	9.6	27.7	49.0
Food Sales/Service	9.6	98.7	74.7	49.6	40.8	3.5	11.7	34.1
Health Care	1.5	100.0	90.2	75.4	55.7	4.9	29.5	Q
Lodging	2.7	98.1	74.0	58.7	41.3	7.7	23.1	45.8
Mercantile/Services	27.1	94.3	65.8	47.4	28.7	1.5	8.4	42.4
Office	14.6	98.6	86.1	58.7	48.3	4.4	15.5	44.3
Residential	6.0	99.6	72.8	47.2	37.9	Q	8.5	Q
Warehouse	10.8	72.9	71.9	49.4	36.1	0.6	9.7	46.7
Other	4.5	77.1	79.7	52.9	45.7	2.9	13.8	Q
Vacant	7.1	48.8	118.2	86.1	65.0	2.2	4.4	50.0
Census Region								
Northeast	17.0	93.7	73.9	49.4	37.1	3.8	12.9	55.6
North Central	30.7	92.1	77.8	53.9	40.5	3.2	10.8	45.0
South	37.8	88.2	76.0	54.1	36.3	2.1	11.7	37.7
West	14.5	86.4	79.6	56.9	40.9	3.6	15.7	38.5
Fuel Used For Heating								
Electricity	28.0	99.5	79.4	58.4	47.0	3.5	NA	NA
Natural Gas	50.9	100.0	72.8	49.1	35.7	2.9	NA	NA
Fuel Oil	14.3	100.0	58.6	49.1	29.3	2.1	NA	NA
Propane	4.1	99.4	70.0	49.4	43.1	Q	NA	NA
Purchased Steam	1.4	100.0	74.5	63.6	21.8	16.4	NA	NA
Other	4.3	98.8	60.7	50.6	39.9	1.2	NA	NA

Q = data withheld either because RSE was greater than 50%, or fewer than 20 buildings were sampled.
NA = Information was not available.

Note: Columns do not sum to the total for heated and/or cooled buildings.

Source: Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings: 1983. U.S. DOE/EIA, July 1985.

TABLE 7.16 Energy Conservation In Commercial Buildings, 1983
(Percentages for Number of Buildings)

FIGURE 7.14 Energy Conservation Measures in Commercial Buildings, 1983

Remarks:

1. Energy conserving features are strongly correlated with the age of the building. These features are more commonly found on newer buildings, less commonly on old. Larger buildings are slightly more likely than smaller buildings to have these energy conserving features.
2. Of the four census regions the Northeast has the highest percentage of buildings with heating and/or cooling. It has the lowest reported incidence of insulated glass and roof/ceiling and wall insulation, however. On the plus side, it may have use a slightly higher percentage of computerized controls and it has the highest reported response rate to the recommendations of professional energy audits.

CHAPTER EIGHT: ENERGY CONSUMPTION, PRICES, AND EXPENDITURES OF THE COMMERCIAL BUILDINGS SECTOR

This chapter provides information on energy consumption by the buildings component of the U.S. commercial end-use sector. The commercial buildings need to be distinguished from the commercial sector as a whole, which includes such nonbuilding energy consumers as streetlights, bridges, and construction sites. The information in this chapter comes from the State Energy Data Report, the Monthly Energy Review, the Nonresidential Buildings Energy Consumption Survey: 1979, Consumption and Expenditures, Part 2, and the Annual Energy Review, all of which are Energy Information Administration publications.

This chapter is comprised of the following sections:

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8.3	Regional Comparisons of Total and Average Energy Consumption by the Commercial Buildings Sector	8.6
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8.7	Federal Agency Energy Consumption, 1975 - 1984, by Agency and Fuel Type	8.14
8.8	Commercial Sector Energy Prices, 1970 through 1982	8.16

8.1 HISTORICAL ENERGY CONSUMPTION BY THE U.S. COMMERCIAL BUILDINGS SECTOR,
1960 - 1984, BY FUEL TYPE

Year	Coal	Gas	Petroleum	Elec. Sales	Total End-Use Energy Consumed	Electrical Energy Losses	Total Primary Energy Consumed
1960	569.9	1,055.9	1,227.5	542.7	3,396.0	1,355.3	4,751.3
1961	518.9	1,114.5	1,247.5	570.7	3,451.6	1,395.6	4,847.2
1962	514.1	1,248.9	1,279.7	619.6	3,662.3	1,493.6	5,155.9
1963	438.0	1,307.1	1,262.2	686.8	3,694.1	1,644.2	5,338.3
1964	374.1	1,418.7	1,246.9	738.0	3,777.7	1,759.2	5,536.9
1965	355.5	1,489.8	1,386.5	789.1	4,020.9	1,885.4	5,906.3
1966	358.4	1,676.3	1,435.7	859.1	4,329.5	2,062.0	6,391.5
1967	307.1	2,021.7	1,483.1	926.0	4,737.9	2,212.5	6,950.4
1968	275.4	2,140.1	1,510.1	1,015.6	4,941.2	2,423.6	7,364.8
1969	260.0	2,323.1	1,519.8	1,109.7	5,212.6	2,652.0	7,864.6
1970	216.4	2,472.9	1,551.1	1,203.2	5,443.6	2,922.1	8,365.7
1971	203.0	2,586.8	1,509.8	1,290.1	5,589.7	3,125.8	8,715.5
1972	156.2	2,678.4	1,530.0	1,409.5	5,774.1	3,390.3	9,164.4
1973	150.1	2,649.0	1,565.5	1,518.7	5,883.3	3,642.1	9,525.4
1974	153.1	2,617.0	1,422.7	1,502.1	5,694.9	3,668.0	9,362.9
1975	124.6	2,558.5	1,309.7	1,597.7	5,590.5	3,858.0	9,448.5
1976	121.4	2,718.4	1,460.9	1,677.5	5,978.2	4,041.2	10,019.4
1977	122.4	2,548.3	1,510.9	1,753.9	5,935.5	4,236.4	10,171.9
1978	129.7	2,642.7	1,449.8	1,814.3	6,036.5	4,441.1	10,477.6
1979	115.4	2,836.1	1,334.1	1,853.8	6,139.4	4,477.6	10,617.0
1980	87.9	2,673.6	1,287.5	1,906.6	5,955.6	4,638.2	10,593.8
1981	99.9	2,585.3	1,090.2	2,033.1	5,808.5	4,844.7	10,653.2
1982	114.3	2,673.3	1,008.4	2,077.2	5,873.2	4,986.0	10,859.2
1983	119.5	2,508.0	888.0	2,118.4	5,633.9	5,080.3	10,714.2
1984e	129.0	2,639.0	935.0	2,248.0	5,951.0	5,291.0	11,242.0

Source: State Energy Data Report, U.S. DOE/EIA, May 1985.

Note: e = estimated. Residential and commercial data based on ratios for residential and commercial consumption to total combined residential/commercial consumption as contained in the State Energy Data Report, May 1985, updated with 1984 information from the Monthly Energy Review, U.S. DOE/EIA, April 1985. Industrial and transportation data from the Monthly Energy Review, April 1985.

TABLE 8.1 Historical Energy Consumption by the Commercial Buildings Sector, by Fuel Type, 1960 - 1984 (Trillion BTUs)

FIGURE 8.1 Total Primary Energy Consumption by the Commercial Buildings Sector 1960 - 1984

FIGURE 8.2 Commercial Sector Energy Consumption by Fuel Type 1960 - 1984

FIGURE 8.3 Commercial Building Sector Fuel Shares, 1960 and 1984

Remarks:

1. The information contained in this chapter was originally obtained through the Nonresidential Buildings Energy Consumption Survey and was originally published in an EIA report. Users of this data should exercise caution when comparing NBECS data with other energy consumption estimates for the commercial sector. The population of commercial buildings, which is described by the NBECS data, is not equivalent to the entire commercial sector. The commercial sector also encompasses a sizeable population of non-building energy consumers, such as street lights, pumps, bridges, and construction sites. This chapter contains only NBECS data and thus describes only the buildings component of the commercial sector.

8.2 COMMERCIAL BUILDING SECTOR END USE ENERGY CONSUMPTION DURING 1979, BY REGION AND FUEL TYPE

	All Fuels	Natural Gas	Electricity	Fuel Oil/ Kerosene	LPG	Steam
U.S.	5.457	2.354	2.055	0.791	0.053	0.204
NORTHEAST	1.399	0.509	0.457	0.364	(Q)	0.065
NORTH CENTRAL	1.984	1.086	0.643	0.141	0.019	0.095
SOUTH	1.490	0.488	0.700	0.257	0.019	0.026
WEST	0.583	0.270	0.255	0.029	0.011	0.018

Note: Q = data withheld because of large variances.

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.2 Commercial Building Sector End Use Energy Consumption by Region and Fuel Type, 1979 (Quadrillion BTUs)

FIGURE 8.4 Commercial End Use Energy Consumption by Region and Fuel Type, 1979

8.3 REGIONAL COMPARISONS OF TOTAL AND AVERAGE ENERGY CONSUMPTION BY THE COMMERCIAL BUILDINGS SECTOR

Region	Number of Buildings (Thousands)	Total Square Footage (Millions)	Average Square Feet per Building (Thousands)	Total Energy Consumed (Quadrillion BTUs)	Average Amount Consumed per Building (Million BTUs)	Average Amount Consumed Square Foot (Thousand BTUs)
United States	3,879	47,330	12.2	5.457	1,407	115
Northeast	686	11,243	16.4	1.399	2,039	124
North Central	1,226	15,259	12.4	1.984	1,619	130
South	1,408	14,033	10.0	1.490	1,058	106
West	559	6,794	12.2	0.583	1,044	86

TABLE 8.3 Total and Average Energy Consumption by the Commercial Buildings Sector During 1979, by Region

FIGURE 8.5 Average Energy Consumption per Building During 1979, by Region

8.4 COMMERCIAL BUILDINGS SECTOR ENERGY CONSUMPTION DURING 1979 BY BUILDING TYPE

Building Type	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	5.457	1,407	115
Assembly	0.412	930	82
Automotive Sales & Service	0.222	556	122
Education	0.509	3,149	87
Food Sales	0.348	950	187
Health Care	0.441	10,080	262
Lodging	0.269	2,671	134
Office	1.014	1,691	124
Retail/Services	0.662	928	87
Warehouse & Storage	0.648	1,774	108
Other	0.574	2,498	184
Vacant	0.082	761	80

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.4 Commercial Buildings Sector Energy Consumption During 1979 by Building Type, U.S. Totals

Building Type	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	1.399	2,039	124
Assembly	0.068	1,190	62
Automotive Sales & Service	0.056	734	113
Education	0.116	4,963	84
Food Sales	0.059	1,054	160
Health Care	0.107	(0)	269
Lodging	0.057	4,481	129
Office	0.286	2,739	144
Retail/Services	0.138	1,210	90
Warehouse & Storage	0.073	1,485	76
Other	(0)	(0)	(0)
Vacant	(0)	1,002	(0)

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.5 Commercial Building Energy Consumption by Building Type, 1979 Northeast Region

Building Type	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	1.984	1,619	130
Assembly	0.190	1,306	119
Automotive Sales & Service	0.105	719	182
Education	0.185	5,293	95
Food Sales	0.148	1,255	211
Health Care	0.167	9,504	242
Lodging	0.067	5,847	114
Office	0.330	1,713	147
Retail/Services	0.220	966	87
Warehouse & Storage	0.306	2,534	158
Other	0.154	2,258	131
Vacant	0.028	775	94

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.6 Commercial Buildings Sector Energy Consumption by Building Type, North Central Region, 1979

Building Type	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	1.490	1,058	106
Assembly	0.103	532	61
Automotive Sales & Service	0.038	319	93
Education	0.158	2,100	87
Food Sales	0.102	735	200
Health Care	0.138	9,211	322
Lodging	0.112	2,067	163
Office	0.270	1,364	112
Retail/Services	0.209	756	82
Warehouse & Storage	0.210	1,676	107
Other	0.077	862	106
Vacant	0.032	738	78

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.7 Commercial Building Energy Consumption by Building Type, 1979, Southern Region

Building Type	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	0.583	1,044	86
Assembly	0.050	(Q)	(Q)
Automotive Sales & Service	0.023	400	69
Education	0.049	1,770	71
Food Sales	0.039	729	137
Health Care	0.029	(Q)	169
Lodging	0.033	1,472	114
Office	0.128	1,225	83
Retail/Services	0.095	996	92
Warehouse & Storage	0.059	846	53
Other	0.055	1,443	116
Vacant	(Q)	(Q)	(Q)

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.8 Commercial Buildings Sector Energy Consumption by Building Type, Western Region, 1979

FIGURE 8.6 Average Energy Consumption per Building, by Building Type, 1979

8.5 END USE ENERGY CONSUMPTION OF THE COMMERCIAL BUILDINGS SECTOR BY BUILDING AND FUEL TYPE

Building Type	All Fuels	Natural Gas	Electricity	Fuel Oil/ Kerosene	LPG	Steam
Assembly	0.412	0.207	0.122	0.058	0.007	0.018
Auto. Sales & Service	0.222	0.109	0.063	0.045	(Q)	(Q)
Education	0.509	0.211	0.162	0.106	0.002	0.027
Food Sales	0.348	0.136	0.185	0.014	0.008	0.004
Health Care	0.441	0.209	0.116	0.095	(Q)	0.020
Lodging	0.269	0.109	0.116	0.019	(Q)	0.024
Office	1.014	0.346	0.482	0.123	0.003	0.060
Retail/Services	0.662	0.304	0.292	0.053	0.007	(Q)
Warehouse & Storage	0.648	0.290	0.230	0.102	(Q)	(Q)
Other	0.574	(Q)	0.198	0.076	0.002	0.020
Vacant	0.082	0.029	0.034	0.014	(Q)	(Q)

Note: Q = data withheld because of large variances.

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.9 End Use Energy Consumption of the Commercial Buildings Sector, by Building and Fuel Type during 1979

FIGURE 8.7 End Use Consumption by Building and Fuel Type, 1979

8.6 COMMERCIAL BUILDING SECTOR ENERGY CONSUMPTION DURING 1979 BY REGION AND BUILDING AGE

Year Constructed	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	5.457	1,407	115
1900 or Earlier	0.361	1,139	105
1901 to 1920	0.501	1,247	93
1921 to 1945	1.107	1,467	124
1946 to 1960	1.063	1,089	111
1961 to 1970	1.229	1,706	123
1971 to 1973	0.517	2,549	141
1974 to 1979	0.679	1,342	108

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.10 Commercial Buildings End Use Energy Consumption During 1979 by Age of Building, U.S. Totals

Year Constructed	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	1.399	2,039	124
1900 or Earlier	0.157	1,338	113
1901 to 1920	0.135	1,281	76
1921 to 1945	0.418	2,580	166
1946 to 1960	0.231	1,701	113
1961 to 1970	0.268	2,559	131
1971 to 1973	0.085	3,956	146
1974 to 1979	0.105	2,674	120

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.11 Commercial Building End Use Energy Consumption During 1979 by Age of Buildings, Northeast Region

Year Constructed	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	1.984	1,619	130
1900 or Earlier	0.154	1,259	114
1901 to 1920	0.213	1,311	105
1921 to 1945	0.423	1,716	158
1946 to 1960	0.398	1,399	131
1961 to 1970	0.411	2,070	131
1971 to 1973	0.141	2,402	140
1974 to 1979	0.244	1,598	120

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.12 Commercial Buildings End Use Energy Consumption During 1979 by Age of Building, North Central Region

Year Constructed	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	1.490	1,058	106
1900 or Earlier	0.036	694	65
1901 to 1920	0.106	1,147	104
1921 to 1945	0.166	705	66
1946 to 1960	0.322	796	101
1961 to 1970	0.430	1,368	132
1971 to 1973	0.209	2,356	158
1974 to 1979	0.221	1,002	102

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.13 Commercial Building End Use Energy Consumption During 1979 by Age of Buildings, Southern Region

Year Constructed	Total Amount Consumed (10 ¹⁵ Btu)	Average Amount Consumed Per Building (Million Btu)	Average Amount Consumed Per Square Foot (Thousand Btu)
All Commercial Buildings	0.583	1,044	86
1900 or Earlier	(Q)	551	87
1901 to 1920	0.047	1,134	81
1921 to 1945	0.100	904	81
1946 to 1960	0.112	738	84
1961 to 1970	0.120	1,170	77
1971 to 1973	0.082	(Q)	108
1974 to 1979	0.109	1,163	93

Note: Q = data withheld because of large variances.

Source: Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures Part 2, EIA, December, 1983.

TABLE 8.14 Commercial Buildings End Use Energy Consumption During 1979 by Age of Building, Western Region

FIGURE 8.8 Average End Use Energy Consumption per Building During 1979 by Building Age, U.S. Totals

8.7 FEDERAL AGENCY ENERGY CONSUMPTION, 1975 TO 1985, BY AGENCY AND FUEL TYPE

Activity	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Agency											
Defense	1,558.1	1,386.8	1,398.4	1,365.7	1,384.6	1,394.8	1,455.4	1,484.3	1,475.1	1,524.1	1,525.8
Energy	85.2	87.2	87.9	87.1	86.8	84.0	85.3	88.9	91.3	95.6	96.9
Postal Service	59.2	58.3	62.9	58.6	56.0	52.3	50.9	49.4	48.4	50.5	50.9
Veterans Administration	39.2	36.5	37.9	39.4	38.5	38.2	37.4	38.0	38.7	40.0	40.6
General Services Administration	43.0	41.1	41.1	41.3	40.5	38.9	39.1	38.9	37.8	38.0	35.4
Transportation	28.5	27.4	28.8	28.9	27.6	27.6	28.0	28.5	28.7	29.2	29.2
NASA	26.4	25.1	24.0	22.4	22.4	21.4	21.2	21.8	22.4	23.0	21.3
Agriculture	11.9	11.6	10.8	11.2	11.6	11.2	10.9	10.4	10.4	10.7	10.2
Interior	12.3	13.1	13.5	12.3	13.6	11.7	10.7	10.7	10.8	11.8	9.3
Health and Human Services	9.3	9.6	9.9	9.6	9.7	9.5	10.6	10.2	10.3	10.8	10.8
Justice	7.1	7.1	7.5	7.4	8.1	7.4	7.1	7.7	7.6	8.9	8.9
Other*	14.8	15.6	16.5	17.6	16.7	16.6	17.1	18.5	16.9	17.7	18.6
Total	1,895.0	1,719.4	1,739.2	1,701.5	1,716.2	1,713.5	1,773.7	1,807.3	1,798.6	1,860.2	1,859.9
Energy Source											
Petroleum											
Motor Gasoline	63.4	60.5	61.5	60.2	58.6	56.1	52.9	52.8	51.8	51.0	50.3
Aviation Gasoline	21.1	11.6	8.8	6.2	4.7	4.9	4.6	3.6	2.5	1.9	1.5
Jet Fuel	707.4	610.0	619.2	601.1	618.6	638.7	653.3	672.7	673.3	693.7	705.9
Distillate and Residual Fuel Oil	364.7	329.7	348.5	332.4	327.1	307.8	351.3	349.5	329.4	342.9	323.4
Liquefied Petroleum Gases	5.4	4.6	4.1	3.0	3.7	4.0	3.7	3.8	4.0	4.1	4.0
Subtotal	1,162.0	1,016.4	1,042.1	1,002.9	1,012.7	1,011.5	1,065.8	1,082.4	1,061.0	1,093.6	1,085.1
Electricity	481.2	473.5	479.7	479.2	479.8	482.2	491.5	501.7	515.2	530.1	546.0
Natural Gas	166.2	151.8	141.1	144.7	148.9	147.3	142.2	145.9	147.7	157.4	145.8
Coal	77.9	71.3	68.4	66.0	65.1	63.6	65.1	68.6	62.4	65.3	65.0
Purchased Steam	7.6	6.3	7.7	8.6	9.7	9.1	9.1	8.5	12.3	13.8	18.6
Total	1,895.0	1,719.4	1,739.2	1,701.5	1,716.2	1,713.5	1,773.7	1,807.3	1,798.6	1,860.2	1,859.9

* Preliminary. Energy usage data for Department of Transportation, Health and Human Services, Department of Labor, Department of Justice, and Federal Communications Commission are estimated.

* Includes Department of Commerce, Panama Canal Commission, Tennessee Valley Authority, Department of Labor, National Science Foundation, Department of Treasury, Federal Communications Commission, and Environmental Protection Agency. Environmental Protection Agency and the Department of Treasury data for 1982 are estimated. Department of Treasury data for 1984 are estimated.

Note: Sum of components may not equal total due to independent rounding.

Note: These data include energy consumed at foreign installations and in foreign operations, including aviation and ocean bunkering, primarily by the Department of Defense. U.S. Government energy use for electricity generation and uranium enrichment is excluded. However, other energy used by U.S. agencies that produce electricity or enrich uranium is included.

Source: Department of Energy Form DOE 6200-2, "Quarterly Federal Energy Usage Report."

TABLE 8.15 Federal Government Energy Consumption by Agency and Fuel Type
Fiscal Years 1975 through 1985
(Trillions of BTUs)

	Petroleum				Electricity	Natural Gas	Coal and Other ²	Total
	Motor Gasoline	Distillate and Residual Fuel Oils	Other ¹	Total				
1975								
Defense	34.9	326.5	725.5	1,086.8	296.3	119.9	55.1	1,558.1
Energy	1.3	5.2	0.3	6.8	49.2	9.8	19.4	85.2
Postal Service	10.3	4.6	0.7	15.6	40.5	2.5	10.6	59.2
Veterans Administration	0.6	5.6	(*)	6.2	16.6	14.6	1.8	39.2
General Services Administration	0.2	2.6	0	2.7	29.3	4.9	6.1	43.0
Transportation	1.5	7.8	4.7	14.0	12.9	1.3	0.3	28.5
NASA	0.4	1.8	1.2	3.4	17.9	3.9	1.2	26.4
Agriculture	4.6	1.4	0.5	6.6	3.4	2.0	(*)	11.9
Interior	2.6	2.9	0.7	6.1	4.1	2.0	0.1	12.3
Health and Human Services	0.7	2.8	0.1	3.7	3.9	1.6	0.1	9.3
Justice	2.0	0.8	(*)	2.8	1.9	2.1	0.4	7.1
Other ⁴	4.3	2.8	0.2	7.3	5.3	1.6	0.4	14.8
Total	63.4	364.7	733.9	1,162.0	481.2	166.2	85.5	1,895.0
1985 ⁵								
Defense	25.5	297.1	702.2	1,024.7	343.6	106.3	51.3	1,525.8
Energy	1.4	3.6	0.7	5.7	63.3	6.5	21.4	96.9
Postal Service	9.9	3.1	0.2	13.2	32.6	4.5	0.7	50.9
Veterans Administration	0.5	2.2	(*)	2.8	22.7	13.9	1.3	40.6
General Services Administration	0.1	0.6	0	0.7	28.2	3.1	3.3	35.4
Transportation	1.4	8.1	5.0	14.5	13.2	1.2	0.3	29.2
NASA	0.3	0.8	1.6	2.7	17.5	2.6	0.5	23.3
Agriculture	4.0	0.7	0.4	5.0	4.0	1.2	(*)	10.2
Interior	2.2	1.5	0.8	4.6	3.2	1.3	0.2	9.3
Health and Human Services	0.4	2.6	0.1	3.1	6.3	1.5	(*)	10.8
Justice	1.8	0.4	0.1	2.3	3.5	2.7	0.4	8.9
Other ⁴	3.1	2.7	0.4	6.1	10.3	1.9	0.5	18.6
Total	50.3	323.4	711.5	1,085.2	548.8	146.7	80.0	1,859.9

¹ Includes aviation gasoline, jet fuel, and liquefied petroleum gases.

² Includes purchased steam.

³ Less than 50 billion Btu.

⁴ Includes Department of Commerce, Panama Canal Commission, Tennessee Valley Authority, Department of Labor, National Science Foundation, Department of Treasury, Federal Communications Commission, and Environmental Protection Agency.

⁵ Preliminary.

⁶ Includes Department of Commerce, Panama Canal Commission, Tennessee Valley Authority, National Science Foundation, Department of Treasury, and Environmental Protection Agency.

Note: Sum of components may not equal total due to independent rounding.

Note: These data include energy consumed at foreign installations and in foreign operations, including aviation and ocean bunkering, primarily by the Department of Defense. U.S. Government energy use for electricity generation and uranium enrichment is excluded. However, other energy used by U.S. agencies that produce electricity or enrich uranium is included.

Source: Department of Energy Form DOE 6200-2, "Quarterly Federal Energy Usage Report."

TABLE 8.16 Federal Agency Energy Consumption Fuel Type
Fiscal Years 1975 through 1985
(Trillions of BTUs)

8.8 COMMERCIAL SECTOR ENERGY PRICES, 1970 THROUGH 1982

Year	Coal	Natural Gas	Distillate Fuel	Kerosene	LPG and Ethane	Motor Gasoline	Residual Fuel	Electricity	Commercial Average
1970	0.41	0.75	1.10	0.77	1.28	2.86	0.50	6.16	1.98
1971	0.41	0.80	1.16	0.82	1.36	2.91	0.67	6.52	2.17
1972	0.45	0.86	1.17	0.81	1.36	2.90	0.71	6.76	2.35
1973	0.45	0.92	1.37	0.97	1.47	3.11	0.86	7.14	2.60
1974	0.86	1.05	2.28	2.17	2.60	4.33	1.92	9.02	3.45
1975	1.14	1.32	2.47	2.33	2.67	4.66	2.03	10.25	4.14
1976	1.08	1.62	2.65	2.67	2.93	4.81	1.98	10.98	4.46
1977	1.16	2.00	3.02	2.97	3.44	5.12	2.27	12.17	5.21
1978	1.27	2.20	3.18	3.15	3.53	5.28	2.20	13.12	5.65
1979	1.26	2.69	4.51	4.81	3.99	7.09	3.10	13.49	6.23
1980	1.36	3.32	6.53	6.47	5.17	9.68	4.44	16.25	7.97
1981	1.52	3.89	8.06	7.77	5.95	10.88	5.48	18.68	9.65
1982	1.67	4.73	7.84	7.51	6.28	10.41	4.87	20.23	10.51

Source: State Energy Price and Expenditure Report, 1970-1982
U.S. DOE/EIA, April 1985.

TABLE 8.17 Fuel Prices for the Commercial Sector in Current Dollars,
1970 - 1982
(Current Dollars per Million BTUs)

Year	Coal	Natural Gas	Distillate Fuel	Kerosene	LPG and Ethane	Motor Gasoline	Residual Fuel	Electricity	Commercial Average
1970	1.00	1.83	2.69	1.88	3.13	6.99	1.22	15.05	4.84
1971	0.95	1.86	2.70	1.91	3.17	6.77	1.56	15.17	5.05
1972	1.01	1.92	2.61	1.81	3.04	6.48	1.52	15.10	5.25
1973	0.95	1.94	2.89	2.05	3.11	6.57	1.82	15.09	5.49
1974	1.67	2.04	4.43	4.21	5.05	8.41	3.73	17.51	6.70
1975	2.02	2.34	4.39	4.14	4.74	8.28	3.61	18.21	7.15
1976	1.82	2.74	4.47	4.51	4.95	8.12	3.34	18.54	7.53
1977	1.85	3.19	4.82	4.74	5.49	8.17	3.62	19.42	8.31
1978	1.89	3.27	4.72	4.68	5.24	7.84	3.27	19.49	8.39
1979	1.72	3.68	6.17	6.58	5.46	9.69	4.24	18.44	8.52
1980	1.70	4.16	8.18	8.10	6.47	12.12	5.56	20.35	9.98
1981	1.74	4.44	9.21	8.88	6.80	12.43	6.26	21.34	11.02
1982	1.80	5.10	8.45	8.09	6.77	11.22	5.25	21.80	11.32

Source: State Energy Price and Expenditure Report, 1970-1982 U.S. DOE/EIA, April 1985.

TABLE 8.18 Fuel Prices for the Commercial Sector in 1984 Dollars
1970 - 1982
(1984 Dollars per Million BTUs)

FIGURE 8.9 Commercial Sector Energy Prices in Current Dollars, 1970 - 1982

FIGURE 8.10 Commercial Sector Energy Prices in 1984 Dollars, 1970 - 1982

FIGURE 8.9. Commercial Sector Energy Prices in Current Dollars, 1970-1982

FIGURE 8.10. Commercial Sector Energy Prices in 1984 Dollars, 1970-1982

CHAPTER NINE: ADDITIONAL BUILDINGS AND COMMUNITY SYSTEMS INFORMATION

Data is provided to BCS to facilitate R&D and program planning. The data include BEAS (Buildings Energy Accounting System, maintained by Pacific Northwest Laboratory) and BECA (Buildings Energy-Use Compilation and Analysis, maintained by Lawrence Berkeley Laboratory).

BEAS is composed of three databases of information pertaining to energy consumption in the buildings sector. The information is taken from U.S. DOE Energy Information Administration, the U.S. Bureau of the Census, the National Oceanic and Atmospheric Administration, and various trade associations and national laboratories. The information is aggregated into four components within BEAS:

1. the core dataset,
2. the core database,
3. the auxiliary database, and
4. the Buildings and Community Systems Databook.

The BECA database contains information on the actual performance and cost effectiveness of buildings that have been designed or retrofitted to conserve energy. BECA has over 2,200 computerized entries representing thousands of occupied, energy-efficient buildings in the U.S. and abroad.

The following parts of this section provide some of the information contained in BEAS and BECA. The final portion of this section contains a description of the Overview of Building Energy Use and Report of Analyses prepared by Brookhaven National Laboratory. The Overview of Building Energy Use and Report of Analyses summarizes the overall trends in energy consumption in the buildings sector and the ongoing analyses performed by Buildings and Community Systems.

<u>Section Number</u>	<u>Section Title</u>	<u>Page Number</u>
9.1	Buildings Energy Accounting System	9.2
9.2	Buildings Energy-Use Compilation	9.21
9.3	Overview of Building Energy Use and Report of Analyses	9.44

9.1 The Buildings Energy Accounting System (BEAS)

BEAS is composed of four components: the core database, the core dataset, the auxiliary database, and the Buildings and Community Systems Data Book (See Figure 9.1). The Buildings and Community Systems Databook provides a hard copy of the pertinent files contained in the computerized BEAS core database and core dataset. The Buildings and Community Systems Data Book also contains a copy of the BEAS auxiliary database.

The core database, the largest section of BEAS, provides a compilation of all available data pertinent to energy consumption in the residential and commercial sectors, including all the information in the Buildings and Community Systems Data Book. This information consists of data on energy prices, consumption, building characteristics, major fuel-consuming equipment, and energy savings as a result of BCS projects. These datasets are designed to be detailed and will contain, for example, regional disaggregations of data and historical information that predates 1973. The core database is scheduled to be completed by summer 1986.

The core dataset, designed to contain the most frequently referenced data, is essentially a subset of some of the information found in the core database. The core dataset gives only national statistics. Energy consumption and prices by sector and by fuel type are part of the information included in the core dataset. The core dataset is currently available on a disk for the IBM PC using Symphony software and can be obtained by contacting:

Richard Scheer
Pacific Northwest Laboratory
2030 M St., NW
Washington, D.C. 20036
(202) 785-8400

The auxiliary database, a component of BEAS, describes pertinent databases not already referenced in the other components of BEAS. The databases referenced in the BEAS auxiliary database tend to be large and highly specialized. For this reason, BEAS provides only a description of and directions for obtaining the actual data from the large and specialized databases in the auxiliary database. The auxiliary database is reviewed in the following paragraphs.

FIGURE 9.1 Building Energy Accounting System

Description of the Auxiliary Database

As depicted in Figure 9.1, the auxiliary database is organized by name of the government agency, trade association or private company. The organizations included in the current version of the auxiliary database include the U.S. Bureau of the Census, the National Climatic Data Center, the Edison Electric Institute, the American Gas Association, the Gas Appliance Manufacturers Association, the Home Appliance Manufacturers Association, the Building Owners and Managers Association, F.W. Dodge Division of McGraw-Hill, and NAHB Research Foundation. Subsequent versions of the auxiliary database will include extensive data from the Lawrence Berkeley Laboratory (noted as BECA Data and LBL International Data on Figure 9.1) and other organizations not yet identified.

For each of the databases presently listed, descriptions of the survey and compiled results are provided. Analytical applications of the database information are also noted. The information for obtaining the database information is summarized in Table 9.1 of this report on the following page.

U.S. Bureau of the Census

The scope of the U.S. census has broadened considerably since 1790 when the first census of the population was taken. Presently, the U.S. Bureau of the Census compiles data on almost every aspect of American life. Statistics from the Bureau's Annual Housing Survey and Characteristics of New Housing are already provided in the BEAS. Other data from the U.S. Bureau of Census may also be useful to researchers analyzing energy consumption and conservation the residential and commercial sectors.

- Building Permits Survey

The number of building permits issued by local jurisdictions are surveyed in order to gauge the type and amount of new building construction. From this survey, statistics for both the residential and commercial buildings are derived.

- Description of the Survey

Name of Database	Applicable Sector	Organization or Government Agency	Contact	Address Phone Number
1. <u>Building Permits Survey</u> (data tape only)	Residential & Commercial	U.S. Bureau of the Census	Carl Dressner	U.S. Department of Commerce Bureau of the Census Washington, D.C. 20233 (202) 763-2546
2. <u>State, Regional, and National Monthly and Seasonal Heating (and Cooling) Degree Days, Weighted by Population</u> (documents, data tape)	Residential & Commercial	National Climatic Data Center	—	National Oceanic and Atmospheric Administration National Climatic Data Center Federal Building Asheville, N.C. 28801 (704) 259-0682
3. <u>Statistical Yearbook</u> (document, data tape)	Residential & Commercial	Edison Electric Institute	Vanice Hamilton	Edison Electric Institute 1111 19th Street N.W. Washington, D.C. 20036 (202) 828-7400
4. <u>Gas Facts</u> (document)	Residential & Commercial	American Gas Association	Patrick Curley	American Gas Association 1515 Wilson Blvd. Arlington, VA 22209 (703) 841-8400
5. <u>Gas House Heating Survey</u> (document)	Residential	American Gas Association	Richard Ittelag	(See Above)
6. <u>Commercial Gas Market Survey</u> (document)	Commercial	American Gas Association	Christina Swanson	(See Above)
7. <u>Statistical Highlights</u> (document)	Residential & Commercial	Gas Appliance Manu- facturers Association	—	Gas Appliance Manufacturers Association 1901 N. Moore Street Arlington, VA 22209 (703) 525-9565
8. <u>Experience Exchange Report</u> (document)	Commercial	Building Owners and Managers Association	Caroline Coward	Building Owners and Managers Association 1250 Eye Street N.W. Washington, D.C. 20005 (202) 289-7000
9. <u>F.W. Dodge</u> (data tape only)	Residential & Commercial	F.W. Dodge Division of McGraw-Hill	—	F.W. Dodge Division of McGraw-Hill 29 Hartwell Avenue Lexington, MA 02173 (617) 861-0165
10. <u>NAHB Research Foundation</u> (data tape only)	Residential	NAHB Research Foundation	Robert C. Stroh	NAHB Research Foundation Inc. 627 Southlawn Lane Rockville, MD 20850 (301) 762-4200

TABLE 9.1 Instructions for Obtaining Databases
Referred in BEAS Auxiliary Databases

About 8,000 permit-issuing jurisdictions across the United States are canvassed by the U.S. Bureau of the Census on a monthly and annual basis. The data received from these jurisdictions includes information on the number of buildings, the cost of construction and the number of demolitions. Buildings are identified in terms of residential private housekeeping, nonprivate housekeeping (e.g. motels), and private nonresidential construction.

The data is available on annual basis back to 1970. After 1972, the data is available on a monthly basis.

- Description of Compiled Results

The results of this survey are not published and distributed in document form. Rather, data from this survey is available on machine readable tape. The cost of the tapes varies depending on the level of detail requested by the user. A user handbook accompanies the data tapes. (For information on ordering Building Permits datatape refer to Table 9.1).

Data on the machine readable tape is identified by city, MSA, state, and census region. The data is aggregated by state and region. National statistics are also compiled.

The results of the survey appear to be reliable. The large number of respondents (8,000 permit issuing jurisdictions across the United States) indicates that the geographic coverage is adequate and that a high percentage of the total construction permits are being surveyed. However, there may be proportionately greater representation of construction in large cities since collection of data from all of the smaller jurisdictions would be impossible. The sample size shows little variance over time since the respondents are required by law to comply with the U.S. Bureau of the Census request for information.

The only possible shortcoming is that this database does not represent the exact number of new building constructed. On occasion, some of the buildings permitted may not be constructed or may be constructed and completed after a considerable length of time after the permit was issued.

- Analytical Applications of Database Information

The database on residential and nonresidential building construction permits can be useful to researchers in a number of ways. First, the data can be used to determine the trends in residential and commercial construction on both a regional and national basis. Determination of the trends can be useful in forecasting new construction and the buildings stock for the ultimate purpose of calculating the amount of energy consumed in the residential and commercial sectors.

This data can also be useful to compare with the results of other surveys such as the Characteristics of New Housing generated by the Bureau of the Census and residential and commercial sector data generated by F.W. Dodge. The number of permits issued would be a leading indicator of the number of completions of new housing recorded in the Characteristics of New Housing.

National Climatic Data Center

The National Climatic Data Center in Asheville, NC. is responsible for maintaining databases of information collected from weather bureaus across the country. The National Climatic Data Center is part of the National Oceanic and Atmospheric Administration.

Energy consumption in the residential and the commercial sectors is greatly affected by climatic conditions. The information maintained by the National Climatic Data Center can be useful in measuring the relationship between weather and energy consumption in these sectors.

- State, Regional and National Monthly and Seasonal Heating (Cooling) Degree Days, Weighted by Population
- Description of the Survey

Two similar databases are maintained by the National Climatic Center: one for heating degree days, and the other for cooling degree days. Heating degree days (in degrees Fahrenheit) are calculated by subtracting the mean daily temperature from 65 degrees. Correspondingly, cooling degree days are calculated by subtracting 65 degrees from the mean daily temperature. Negative degree days are interpreted to indicate zero degree days. To calculate state, regional, and national averages, the National Climatic Data Center weights the degree day data by population. The weights currently employed come from the 1980 census.

The databases of heating and cooling degree days extend from 1931 to the present. Monthly and annual averages are calculated. Examples of the information contained in the databases are included in Figure 9.2 and 9.3 in the following pages.

- Description of Compiled Data

Statistics from the degree day databases are published in two publications: State, Regional, and National Monthly and Seasonal Heating Degree Days, Weighted by Population and State, Regional, and National Monthly and Seasonal Cooling Degree Days, Weight by Population. Each is available on an annual subscription basis from the National Climatic Data Center for \$24. A tape of the database for the years 1931 to 1983 is also available. (For further details, refer to Table 9.1.)

The degree day data is published in a timely manner. The data are available within two weeks after the end of the month.

- Analytical Applications of Database Information

The effects of temperature on energy consumption can be measured by relating changes in energy consumption with changes in the outdoor temperature. The mathematical relationships can then be used to explain an anomalous level of energy consumption or determine the level of energy consumption under an assumption of extreme weather conditions.

- Comparative Climatic Data

In addition to the databases of heating and cooling degree days, the National Climatic Data Center also compiles data on the humidity, highest and lowest temperature record, the number of days per year with .01 inch or more of rain, the average total precipitation, percentage of possible sunshine, and wind speed per year. Each of these characteristics are available for about 70 cities nationwide. Data from the Comparative Climatic Data databases is beneficial in modeling household consumption under specific weather conditions such as snow cover and wind speeds.

The current and historical statistics can be ordered from the National Climatic Data Center in the same manner as the State, Regional, and National Monthly and Seasonal Heating Degree Days. (See Table 9.1.)

Edison Electric Institute

The Edison Electric Institute (EEI) is a trade association of U.S. electric utilities. About 200 investor-owned utilities are members of EEI.

EEI collects data from member and nonmember companies on electricity generation and consumption. Two publications resulting from the surveys, the Statistical Yearbook and the Typical Residential Commercial and Industrial Bills, are of particular interest to analysts researching energy consumption in the residential and commercial sectors.

- Statistical Yearbook

Data collected by EEI is used by their member companies to determine the trends in electricity generation, consumption, and prices for company and industry-wide planning. The main survey conducted by EEI is for the Statistical Yearbook.

- Description of the Survey

The data collected for EEI's Statistical Yearbook includes information on electricity sales, revenues and customers. The sales, revenues and customers data are provided by class of service (residential, commercial, and industrial), by state and region.

EEI's membership serves 73% of the total number of electrical customers. Since EEI collects data from nonmember companies as well member companies across the country, the response to their survey is presumed to represent in excess of 73% of the total member electricity customers.

Data from the survey conducted for the Statistical Yearbook extend from 1926 to the present. Calculations for average revenue per kilowatt hour (i.e., average electricity end user price) are tabulated by EEI using data from this survey.

- Description of Compiled Results from Survey

As previously noted, the results of the annual canvass of the investor owned and municipally owned electric utilities are published in the Statistical Yearbook. The cost of the most recent yearbook (1984) is about \$30. EEI also produces a machine readable tape of the Statistical Yearbook. The tape contains 21 years worth of data most of the tables appearing in the yearbook. The

tape sells for about \$250. (For details on ordering the Statistical Yearbook and data tape, refer to Table 9.1.)

EEl publishes the Statistical Yearbook in a timely manner. Preliminary information from the survey is released in seven months after the close of the reporting year. By fall of the same year, copies of the Statistical Yearbook data book are available.

The results of the survey are reliable in that an EEl has an adequate number of members responding to the survey each year. EEl estimates data for companies not responding to the survey, so that the published data is indicative of the entire U.S. electrical industry.

The one drawback in the EEl data is their definition of a customer. In general, electric utility companies count meters, not actual customers. In the commercial and industrial sectors it is conceivable that one customer can be served by more than one meter. Conversely, in the residential sector one meter can serve more than one household.

- Analytical Applications of Database Information

Despite the aforementioned shortcoming, EEl is the only organization collecting information on the number of electrical customers by sector. This data in combination with electricity consumption data can be used to calculate energy intensities for electricity. From this, the level of energy conservation can be determined by analyzing the change in energy intensities from year to year.

- Typical Residential, Commercial and Industrial Bills

Another supplemental EEl database is available on billing information. The data from this database is intended for an EEl publication entitled Typical Residential, Commercial and Industrial Bills which provides data on consumers bills by sector. The data includes information on the amount of taxes customers paid on electrical service. Only investor owned electrical utilities are surveyed for this information.

Data from the Typical Residential, Commercial and Industrial Bills may be useful to an analyst attempting to measure demand elasticity for electricity. The tax component of electricity purchases has an effect on the

level of electricity purchased in as much as the price for the actual service and therefore, should be accounted for in a demand elasticity study.

The Typical Residential, Commercial and Industrial Bills can be ordered from EEI in the same manner as the Statistical Yearbook. (See Table 9.1.)

American Gas Association

The American Gas Association (AGA) is a trade association composed of over 200 gas utility companies that transmit and distribute natural gas. AGA collects data from member and nonmember gas utilities on a variety of topics.

- Gas Facts

Each year AGA surveys the gas industry for information on natural gas sales, revenues and customers for eventual publication in a document called Gas Facts. This survey process is so similar to the one performed by EEI that AGA and EEI coordinate their surveying activities. Each year a single survey form is sent to all utility companies in an attempt to limit the amount of paperwork required of the utility companies.

- Description of the Survey

In the annual survey, AGA receives data from utility companies representing upwards of 85% of all natural gas sales. The companies are adequately dispersed across the United States.

AGA's database of information collected from the Gas Facts survey extends from 1945 to 1984. Figure 9.4 provides an example of information contained in Gas Facts. All of the data collected is on an annual basis with exception of sales. End use sales data is also available on a monthly basis so that seasonal fluctuations in gas sales can be monitored.

- Description of Compiled Results

Gas Facts is available in the fall following the year surveyed at a cost of approximately \$35. For further information on ordering Gas Facts, refer to Table 9.1.

The results of the Gas Facts survey are reliable. A response representing over 85% of natural gas sales is more than adequate. Employing the same technique used at EEI, AGA estimates data for companies not responding to the

annual survey.

AGA's data also has the same drawback as the EEI data. Gas customers are measured in terms of meters. As noted earlier, more than one meter can serve a single commercial or industrial customer while several households can be serviced by a single meter.

Another problem with the AGA data is that it pertains to the gas utility industry only. Natural gas production companies also sell gas to large industrial end users, especially in Texas and Louisiana. This data is not counted in the AGA database because AGA purposely limits the information to utility companies only.

- Analytical Applications of Database Information

The information available in the AGA Gas Facts database is useful for computing energy intensities of natural gas consumption since data is available for both end use gas sales and customers. The level of natural gas conservation is indicated by trends in energy intensities.

Other data in Gas Facts is also useful. The monthly end use sales data allow analysts to determine the seasonal fluctuation in natural gas sales. This data in conjunction with heating degree day information enables an analysis of the relationship between climatic conditions and natural gas used to be performed.

Much of the AGA information can be used to verify EIA data. Both AGA and EIA collect data on end use natural gas sales and prices. In comparing sales data, EIA's data for end use of natural gas sales should be greater since EIA attempts to include producer sales to end users.

- Gas Househeating Survey

AGA has several other databases of information pertaining to the residential and commercial sectors. Most of the responses to the surveys for the supplemental databases come from AGA member companies.

- Description of the Survey.

The Annual Gas Househeating Survey was first conducted in 1947. In the 1983 survey, 157 utility companies responded representing over 88 percent of the nation's residential customers.

In the Gas Househeating Survey, companies are queried as to the number of househeating customers, the total number of residential customers, the presence of new residential customer hook-up restrictions, the amount of gas consumed per customer for heating and for baseload applications, and the year end price of natural gas and other househeating fuels. Much of this information is available on a company-by-company basis thus allowing an evaluation of the data by city. Figure 9.5 provides an example of some of the information collected in the Gas Househeating Survey.

- Description of Compiled Results

The annual Gas Househeating Survey is available in the early fall following the year being surveyed. The cost of the publication is about \$15. For further details on ordering the Gas Househeating Survey see Table 9.1.

The compiled results of the survey are reliable in that gas utility companies serving a large percentage of end use customers respond to the survey each year. A.G.A. estimates information for nonresponding companies in the same manner used for Gas Facts.

- Analytical Application of Database Information

Information from the Gas Househeating Survey is useful for analyzing and comparing residential gas consumption for househeating and baseload applications. AGA's level of detail allows a city-by-city comparison of this type.

The information collected by AGA on residential fuel prices is useful for verifying data published in EIA's State Energy Price and Expenditure Report. The only definitional difference between the two series of numbers is that the AGA has year ending data while the EIA data is average price information for the entire year.

- Commercial Gas Market Survey

AGA collects data on natural gas use in the commercial sector in part to measure the amount of fuel switching in the commercial sector. The data collected for this survey can also be used to characterize natural gas consumption for spaceheating and baseload applications in the commercial sector.

- Description of the Survey

AGA first surveyed member utility companies for specific information pertaining to the commercial sector starting in 1979. The information requested in the annual survey focuses on sales to the commercial sector by SIC code; by applications such as spaceheating, waterheating, cooking, etc.; the number of new commercial customers and the conditions imposed on gas sales (mainly interruptable service). Data is also collected on the percentage of sales to dual fuel capable facilities, the level of consumption as compared to the 1973 usage patterns, and the energy source most competitive to natural gas. An example of the data obtained in the Commercial Gas Market Survey is shown in Figure 9.6.

The number of companies responding to AGA's commercial survey represent greater than 60% of the total sales of natural gas to the commercial sector.

- Description of Compiled Results

The results of the Commercial Gas Market Survey are usually published within a year and half after the end of the study year. The results are compiled in a document available from AGA for a cost of about \$15. (For further information see Table 9.1.)

As with the other AGA studies, the results of the Commercial Gas Market Survey are reliable in that the companies responding represent a large portion of total gas sales. However, this results may be slightly skewed since data is not received from numerous smaller companies.

Another concern pertaining to the reliability of the Commercial Gas Market Survey data is related to the ability of gas companies to accurately identify commercial consumption by SIC. Some of this data is estimated by the utility company.

- Analytical Application of Database Information

AGA has one of the few databases of information on energy consumption in the commercial sector by SIC. Although the AGA data pertains only to natural gas consumption, it is instrumental in determining the application for the energy consumed in the commercial sector.

Gas Appliance Manufacturers Association

- Description of Survey

The Gas Appliance Manufacturers Association (GAMA) is composed of over 250 companies which are engaged in the manufacturing of gas appliances. GAMA surveys member companies for information on the number and type of appliances shipped on a monthly basis in order to determine the trend in appliance sales. The information ultimately is published in GAMA's Statistical Highlights.

Gas appliance manufacturers are queried about the number of residential gas ranges, heating systems for recreational vehicles, direct and central heating equipment, water heaters, grills and clothes dryers shipped on a monthly and annually basis. In addition appliance manufacturers are queried as to the number of water heaters, and space heaters and furnaces that are shipped intended for use in the commercial sector.

GAMA's database is a 30 year time series of information. The annual statistics are available at no charge. The cost to receive the monthly data is a \$12' subscription fee. For information on ordering the Statistical Highlights refer to Table 9.1.

- Description of Compiled Results

The GAMA data is published in a timely manner; usually a month and a half after the month survey. The annual data, which is a summation of the monthly figures is available as soon as the last monthly data is computed.

Included in GAMA's Statistical Highlights is data on free standing and built-in electric ranges. This data comes from the Association of Home Appliance Manufactures. An example of the Statistical Highlights is shown in Figure 9.7.

The reliability of the GAMA information is uncertain. For some categories of gas appliance sales, no attempt is made to estimate data for companies not responding to the survey. Furthermore, when only a single company responds to a certain question on the survey, the data is withheld due to proprietary reasons.

Another problem develops in the interpretation of the data. GAMA's data is defined as manufacturers shipments to wholesalers not appliance sales to

ultimate consumers. Therefore, the data does not accurately portray trends in consumer preferences for appliances. The wholesale purchases are assumed to be indicative of these trends in appliance sales to ultimate consumers, though.

- Analytical Applications of Database Information

In much the same way that the characteristics of new housing are useful to analysts studying long term trends in the housing sector, the GAMA data on gas appliance sales is useful. Despite the weakness in the data, the GAMA information can provide clues as to the existing and future stock of residential and commercial appliances. The GAMA data is disaggregated enough to allow estimates on the amount of total energy consumption based on the type of appliance shipped (and presumably sold).

Association of Home Appliance Manufacturers

The Association of Home Appliance Manufacturers is a trade association of companies manufacturing approximately 90% of the major home appliances in the United States each year. AHAM surveys the membership on the energy efficiency ratings of the various appliances shipped.

- Description of Compiled Results

AHAM has a response rate representing over 80% of total appliance sales. This response rate shows little variance from survey to survey.

Similar to the GAMA data, the AHAM data represents only appliance shipments to wholesalers. The assumption must be made that appliance shipments are indicative of consumer preferences.

- Analytical Applications of Database Information

AHAM is one of the few organizations documenting the trend in appliance efficiencies. The AHAM information is useful in determining the efficiency of the current and future stock of home appliances. The description of the stock can lead to a more accurate estimation of energy consumption in the residential sector.

Building Owners and Managers Association

The Building Owners and Managers Association (BOMA) is a trade association of over 3,000 building owners and managers. Most of the members are located in the United States with a few located in Canada.

BOMA collects statistics on the income and expenses incurred by building owners and managers for the Experience and Exchange Report. The statistics collected by BOMA can be categorized as commercial sector data.

- Description of the Survey

BOMA has conducted a survey of members and some nonmembers on office building income and operating expenses since the 1920s. In 1934, the report changed significantly to the format that is still currently used.

BOMA collects a multitude of information on various building operating expenses such as cleaning expenses and repair costs. In addition, data on occupancy rates, square footage of floorspace per employee and per tenant is compiled. The data most relevant to analysts researching energy conservation in the commercial sector is BOMA's data on energy expenses.

Data on energy expenses, disaggregated by fuel type, has been collected since the mid 1930s. The number of respondents to BOMA's survey has increased rapidly since the mid 1970's. In 1940, responses were received from 480 building owners and managers. In 1966, 547 responses were received. By 1978, over a thousand responses were returned to the Association and between 1978 and 1983, the response rate tripled. In 1983, 3,088 building owners and managers responded to BOMA's survey for the Experience Exchange Report out of 8,000 surveys that were mailed.

- Description of Compiled Results

The results of the BOMA survey are published about a year and half after the end of the year being surveyed. The cost of the Experience Exchange Report is about \$195. Only recent copies of data book are available for sale. Historical information can be obtained from BOMA for fee covering research expenses. For further information on ordering the Experience Exchange Report, refer to Table 9.1.

The compiled results from BOMA's survey are quite detailed. (See Figure 9.8.) The information is available on a city-by-city basis since 1934. After 1978 the data is not only available on a city basis but also by downtown versus suburban area and by private versus government building for the United States and Canada. Since 1970, the greater number of responses has allowed publication of energy costs by building height, age and fuel type.

BOMA's database of office building income and expense information does have several weaknesses that affect its reliability. A comparison of survey samples for the Experience Exchange Report and the EIA's Nonresidential Buildings Energy Consumption Survey shows that large buildings (over 50,000 square feet of floorspace) represented a larger portion of the total buildings in BOMA's sample than in EIA's sample. Moreover, since the sample size changes over the years, the comparability of data from year to year is questionable. Finally, the turnover rate among the respondents is relatively high. In the past ten years, between 20 and 50% of the organizations responding in one year failed to respond in the next. Although this turnover helps to assure that the same biases do not occur year after year, the instability in the database makes it difficult to interpret the results. In order to overcome this weakness, BOMA now publishes tables that present data for identical samples for two and five year time spans.

- Analytical Applications of Database Information

The BOMA data is restricted to office buildings only. Despite this restriction, the data is still useful since office buildings represent a significant portion of commercial sector energy consumption.

Trends in the BOMA data for energy expenses indicate, on average, how much energy savings have occurred over time. The trends also indicate the correlation between the change energy prices and energy usage in office buildings.

F.W. Dodge Division of McGraw-Hill

F.W. Dodge Division of McGraw-Hill Information Systems uses a field staff of about 1500 people to collect building information. Since F.W. Dodge of McGraw-Hill is a private company, the statistics collected by the company are proprietary, though some of the aggregate national figures are published in

federal government documents.

F.W. Dodge collects information pertaining to residential nonresidential building construction and therefore is of use to analysts researching the characteristics of the both residential and commercial buildings.

- Description of the Survey

F.W. Dodge collects data from architects, building planners, permit and licensing boards and construction companies. The information collected primarily covers square feet of floorspace, the type of construction (i.e. building type), and estimated construction costs.

Dodge limits the data collected to projects valued at over \$25,000. Dodge includes a construction project if it is scheduled to begin within 60 days. If the project is delayed, cancelled or modified, the data is adjusted accordingly.

Since 1969, Dodge has collected data from all 50 states and the District of Columbia. Between 1956 and 1968 data was collected from the contiguous 48 states and the District of Columbia. Prior to that, the database lacks information from 13 western states.

- Description of Compiled Results

The F.W. Dodge data is purchased by manufacturing companies to assess the market potential of construction-related goods and services. The cost to receive the full volume of Dodge data is \$35,000 annually. Each year aggregate national data from the Dodge database is published in the U.S. Department of Commerce publications, such as Business Statistics. (See Figure 9.9.)

The F.W. Dodge construction data is compiled according to 200 different building codes. The data is also disaggregated by building type: retail/wholesale, office, auto repair, warehouse, educational, health, public religious, hotels/motels, and miscellaneous. The Dodge data lacks information on building shell characteristics with the exception of statistics on the building frame which is categorized as either steel, wood, reinforced concrete, prefabricated or pre-engineered.

Complete tapes on national on state information is available three weeks after the end of the reporting period. The quick turnaround of compiled results

may be the basis for the comparatively high price for the Dodge information.

- Analytical Applications for Database Information

Although the Dodge data lacks any specific energy-related information, the data can be useful for analyzing construction of buildings. The proprietary information can assist in identifying ongoing or near-term construction projects. This data in combination with other energy usage information such as average consumption by building type, can give an early indication of future energy consumption.

NAHB Research Foundation, Inc.

NAHB Research Foundation, Inc. is a wholly owned subsidiary of the National Association of Home Builders (NAHB). The NAHB is composed of 40,000 home builders across the United States. Statistics collected from home builders pertain to the residential sector.

- Description of Survey

NAHB Research Foundation has conducted a survey of the builder-members of the NAHB since 1974. Fifteen to 20% of the builders typically respond to the survey which currently represents about quarter of a million units constructed. A screening process reduces the number of usable, valid responses to 10% of the number originally distributed. The general categories of information collected by the Foundation include:

Framing	Bathroom Plumbing
Sheathing	Bathroom Equipment
Siding	Faucets
Foundation	Water Heaters
Roofing	Shutters
Insulation	Fireplaces
Flooring	Water Service
Windows	Electrical
Exterior Doors	Security Systems
Garage Doors	Solar Energy
Interior Doors	Decks and Fencing
Kitchen Sinks	Mirrors
Kitchen Cabinets	Interior Finish
Appliances	Heating/Cooling Equipment

The NAHB Research Foundation collects detailed information. In total over 1,000 characteristics of information are collected; 15 to 20 characteristics pertain just to insulation. The survey to builders of single

family detached units is 32 pages long. Figure 9.10 is taken from this survey form.

- Description of Compiled Results

NAHB Research Foundation aggregates their data by state and region. The data is also available by zip code so that a neighborhood-by-neighborhood analysis can be performed.

The results of the annual survey are not published. Rather the information is available on machine readable tape. The cost of the tape depends on the amount of information requested. For information on ordering tapes from the NAHB Research, refer to Table 9.1.

NAHB Research Foundation has conducted several analyses to determine the reliability of their data. In 1976, the NAHB Research Foundation directed a telephone interview of 396 randomly selected nonresponding builders. Results of this survey were compared with a similar sized random sample of respondents to the annual survey. No significant differences were observed between results of telephone interviews surveyed respondents. In addition, the NAHB Research Foundation has compared their data with information from EIA's Residential Energy Consumption Survey for ten characteristics common to both databases. Again, no significant differences were uncovered with the except of slight definitional differences.

- Analytical Applications of Database Information

The NAHB Research Foundation provides the detailed type of information needed to characterize the energy aspects of new residential construction. This information is useful in determining consumer preference purchasing energy conserving homes. Moreover, the data allows an analysis of the future level of energy consumption based on the type of homes being constructed today.

9.2 Buildings Energy Use Compilation and Analysis Project

Background

In 1978, the Lawrence Berkeley Laboratory (LBL) first began to collect and systematically compare measured results from what was then a handful of research projects on energy-efficient houses. Today the "BECA" data base (BECA: Buildings Energy-use Compilation and Analysis) contains over 2200

computerized entries, representing thousands of occupied, energy-efficient buildings in the U.S. and abroad.

The BECA buildings energy data base is the only available source of measured data on the actual performance and cost-effectiveness of buildings that have been designed or retrofitted to save energy. The data have been carefully reviewed and, insofar as possible, expressed in the form of performance indicators that allow comparisons across varying weather and operating conditions.

Measured data are an essential form of feedback to building designers and operating engineers on how well calculations, computer models, and "rules of thumb" actually predict energy performance and dollar savings. Equally important, the availability of hard data on successes and failures can be crucial in giving building owners, developers, utilities, and lenders the confidence to invest in energy-efficiency.

Objectives

The goal of the BECA project is to improve energy efficiency in new and existing buildings by providing designers, owners, managers, policy-makers, and others with feedback on how well technical measures and operating strategies actually work to save energy or peak electric demand, and how this performance translates into net dollar savings. We provide information that will help decision-makers and practitioners make better-informed choices about building design, operation, financing, energy demand forecasting, and public policy.

Approach

Data are obtained from a variety of published and unpublished sources in the U.S. and overseas, often with the direct help of our collaborators in the research community, private industry, and utilities. We calculate normalized performance indices and "echo" the results to our data suppliers, both to verify accuracy and to provide the individual building owner or manager with results that can be compared with other BECA buildings - or with design energy calculations, baseline values, or standards.

Results

A few key findings from the measured data in BECA are listed below:

- As a group, energy-efficient new houses use only about one-third to one-half the heating energy required by "conventional" new houses in the U.S. The best of these state-of-the-art houses use less energy for space heating than for water heating or major appliances - under \$100/year, even in cold areas of the Northern U.S. and Canada (see Table 9.2).
- For retrofits of homes and multifamily buildings we typically find (weather-corrected) heating energy savings of 20-25%, with simple payback times of 5 to 9 years (see Table 9.3). A few buildings, however, show increased energy use after retrofit, indicating either a significant improvement in temperature settings and comfort, or problems in the choice of measures, product or installation quality, or maintenance and operation.
- Our data show that new non-residential buildings designed with special energy-saving features perform at about the level predicted for designs that comply with the latest ASHRAE 90.1P standards (see Table 9.4). New offices, for example, typically use 50-80 kBtu/ft², or about one-half the average energy use for all existing U.S. office buildings. Again, the best BECA buildings are considerably below this level, using as little as 20-40 kBtu/ft².
- Measured savings from non-residential building retrofits are typically 20-25%, as demonstrated by Table 9.14; after retrofit these buildings still use about twice as much energy as the newly-designed energy-efficient buildings in the data base. Non-residential retrofits are very cost-effective; payback times are almost always under 2 or 3 years. Investment strategies are quite conservative; average retrofit costs are about \$.40/ft², or about 4-6 months' energy costs. These indicators suggest that there are many additional, cost-effective opportunities to reduce energy use and costs in existing buildings.
- Comparisons of measured and predicted energy performance show fairly good agreement (within $\pm 20\%$), in cases where well-tested models are run by experienced users, based on accurate, complete building descriptions. In practice, though, these requirements are often not met. Data problems,

including user judgments and assumptions about building operating conditions, appear to be more important sources of prediction error than inaccuracies in the computer models or calculation methods themselves.

Category	#	K-value (Btu °F-day)	Balance Temp. (°F)	Cost of Conserved Energy	
				Elec. homes (\$/MBtu) ^a	Gas homes (\$/MBtu)
All homes	319	8648±4738	55.2±8.5	8.24±8.17	5.29±2.72
Superinsulated	196	6746±3404	59.0±7.2	6.09±8.49	4.14±2.82
Passive Solar	197	6072±4508	50.2±9.4	5.94±8.35	4.43±2.81
Active Solar	26	11224±6670	57.0±7.9	16.81±2.09	-
Earth Sheltered	9	5336±2668	50.4±10.1	-	-

* Values are mean ± standard deviation in parentheses.

^a Electricity is converted in site energy, 3413 Btu/kWh

Source: J.F. Busch and A.K. Meier, "Monitored Performance of New, Low-Energy Homes: Updated Results from the BECA-A database," LBL-18306, Lawrence Berkeley Laboratory, August 1984.

TABLE 9.2 Summary of BECA-A Results*

Remarks

1. Over 300 energy-efficient new houses are represented in the BECA-A database; 90% are in the U.S. or Canada. As a group these houses use only about 30-50% of the heating energy required by "conventional" new U.S. houses. The best houses use less energy for space heat than for water heating or major appliances - under \$100/year, even in colder U.S. climates.
2. On average, buildings with earth-shelter features appear to perform best, that is, have the lowest k-values and balance temperatures, although this finding is tempered by the group's small sample size. Houses with passive solar and superinsulation features have roughly comparable performance. Houses with active solar features perform significantly worse than the other homes; their k-values are roughly twice those of the earth-sheltered homes, indicating, in general, that little attention has been paid to shell thermal integrity to complement the active solar systems.
3. The average cost of conserved energy was less for all homes than current electricity and gas prices (\$19.80/MBtu [site] for electricity and \$6.00/MBtu for gas); superinsulated and passive solar homes were much more cost-effective than homes that relied on active solar systems.

	Sample Size (N)	Percent Savings (median)	Site Energy Savings Median (kBtu/ft ² -yr)
All Offices:			
Large Offices	34	21.4	28.5
Small Offices	13	20.8	32.6
All Schools:			
Elementary	82	27.7	30.4
Secondary	28	24.5	37.7
Colleges	13	44.5	100.7
Retail:	2	12.3	8.0
Hospitals:	8	26.4	93.4
Post Offices:	92	24.0	28.0
Assembly:	2	52.2	188.6
Correctional:	1	6.0	8.5
Other:	14	23.6	23.6

* Electric space heat savings are measured in resource energy units, 11500 Btu/kWh

Source: C.A. Goldman, "Measured Results of Energy Conservation Retrofits in Residential Buildings," ASHRAE Transactions, 92:1, 1986

TABLE 9.3 Summary of BECA-B Results

Remarks:

1. Energy savings actually achieved were typically 20% to 25% of pre-retrofit space heating energy use. There is substantial variation in energy savings for investments of the same magnitude, even after controlling for pre-retrofit energy intensity, building type (e.g., single- vs. multifamily), and climate.
2. The average investment per dwelling unit in multifamily buildings is lower than the average spent in single-family residences. Many conservation measures are attractive economic investments from a homeowner's perspective, compared to other investment possibilities. The median real rate of return for each of the four categories compares favorably with rates of return available from other investments (e.g., 3-5 percent real return on tax-free bonds).

	Sample Size (N=)	Avg. Floor Area (kft ²)	Site Energy Intensity (kBtu/ft ² -yr) ^a		
			Avg.	Median	Std. Dev.
All Offices:	103	249	66	62	25
Large Offices	76	334	69	64	23
Small Offices	27	20	57	47	27
w/ Parking	33	386	68	65	22
w/o Parking	70	185	66	61	26
w/ Computers	32	371	79	74	30
w/o Computers	71	201	60	57	20
All Schools:	21	110	61	55	29
Elementary	10	61	48	42	-
Secondary	5	140	55	50	-
Colleges	6	160	88	87	-
Retail:	6	121	68	57	-
Warehouse:	4	90	44	43	-
Hospital:	2	135	127	-	-
Other:	16	48	62	59	31

^a Energy intensities are calculated using total floor area but excluding enclosed parking.

Source: M.A. Piette and R. Riley, "Energy Use and Peak Power for New Commercial Buildings from the BECA-CN Data Compilation: Key Findings and Issues," LBL-20896, presented at the 13th Annual Energy Technology Conference, Washington, D.C., January, 1986.

TABLE 9.4 Summary of BECA-CN Results

Remarks:

1. Measured energy use of the 150 buildings in the BECA-CN database is roughly comparable to predicted intensities for designs that comply with the proposed ASHRAE Standard 90.1P. BECA-CN offices use about half as much energy as existing U.S. office buildings (from EIA, NBECS data.); energy expenditures are slightly over \$1/ft²-year (in 1985 dollars) on average. The wide range of energy intensities is due in part to differences in occupancy hours and operating conditions among commercial buildings.
2. Average peak demand for BECA-CN office buildings is 5.5 Watts/ft². Peak demand costs are typically 20 to 30 percent of total electric bills.

STATE ALABAMA		STATE HEATING DEGREE DAYS DIVISIONS WEIGHTED BY 1980 POPULATION												--BASE TEMP = 65 DEG F	
SEASON	NAME	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	SEASONAL	
1931/1932	52	0	0	0	61	179	338	434	272	443	90	29	0	1846	
1932/1933	37	0	0	6	144	462	488	452	482	338	129	4	0	2505	
1933/1934	45	0	0	0	92	328	314	513	576	363	91	14	0	2291	
1934/1935	47	0	0	5	83	262	592	558	456	193	89	12	0	2250	
1935/1936	22	0	0	3	75	289	769	669	562	243	141	8	0	2759	
1936/1937	44	0	0	0	85	382	487	323	491	402	114	14	0	2298	
1937/1938	42	0	0	9	147	426	553	577	326	179	99	12	0	2368	
1938/1939	46	0	0	5	83	257	571	511	380	258	134	24	0	2265	
1939/1940	7	0	0	1	80	401	516	1003	572	361	138	46	0	3118	
1940/1941	28	0	0	10	98	342	441	582	616	489	70	8	0	2656	
1941/1942	30	0	0	0	28	361	487	693	599	345	87	19	0	2619	
1942/1943	40	0	0	11	98	264	532	544	435	387	104	8	0	2387	
1943/1944	33	0	0	14	155	417	590	613	318	302	128	9	0	2566	
1944/1945	41	0	0	3	127	340	624	625	402	152	67	41	0	2381	
1945/1946	38	0	0	0	134	281	750	579	417	208	59	28	0	2476	
1946/1947	35	0	0	11	112	191	451	504	468	509	71	32	0	2551	
1947/1948	36	0	0	1	41	388	517	810	415	254	47	20	0	2513	
1948/1949	49	0	0	9	165	284	470	414	365	358	137	12	0	2214	
1949/1950	51	0	0	13	44	383	496	287	349	401	184	7	0	2164	
1950/1951	21	0	0	12	78	485	720	574	442	306	147	27	0	2791	
1951/1952	39	0	0	3	85	483	468	432	404	374	141	16	0	2436	
1952/1953	31	0	0	13	245	383	590	508	451	264	154	8	0	2616	
1953/1954	34	0	0	7	89	384	631	583	381	368	45	72	0	2560	
1954/1955	32	0	0	0	95	422	626	659	460	259	60	10	0	2599	
1955/1956	24	0	0	0	151	400	588	710	353	348	148	17	0	2709	
1956/1957	48	0	0	14	95	417	351	554	292	407	71	16	0	2219	
1957/1958	3	0	0	7	210	315	537	783	761	453	107	21	0	2194	
1958/1959	19	0	0	5	145	289	689	694	459	419	122	11	0	2813	
1959/1960	10	0	0	5	84	408	549	649	591	633	93	51	0	2043	
1960/1961	14	0	0	7	104	357	719	805	394	286	207	54	5	2938	
1961/1962	25	0	0	6	154	294	560	709	318	455	176	4	0	2676	
1962/1963	11	0	0	8	95	413	689	815	665	263	72	22	0	2042	
1963/1964	6	0	0	11	86	360	857	711	637	370	81	19	0	2132	
1964/1965	26	0	0	6	199	276	525	599	542	451	65	17	0	2674	
1965/1966	18	0	0	5	154	265	563	788	526	385	106	39	3	2834	
1966/1967	29	0	0	12	167	321	597	627	593	251	44	41	0	2653	
1967/1968	8	0	0	16	171	445	461	715	706	410	102	39	0	2085	
1968/1969	4	0	0	15	130	418	694	642	549	549	93	27	0	2167	
1969/1970	5	0	0	15	122	441	668	840	583	401	72	22	1	2165	
1970/1971	13	0	0	0	119	463	489	647	554	482	143	65	0	2958	
1971/1972	41	0	0	4	63	385	350	516	520	343	102	39	3	2345	
1972/1973	20	0	0	3	137	434	504	696	581	229	176	58	0	2818	
1973/1974	50	0	0	1	77	245	593	399	502	224	128	18	7	2144	
1974/1975	27	0	0	27	183	373	552	536	428	161	14	14	0	2673	
1975/1976	23	0	0	28	117	331	622	778	370	248	23	87	3	2211	
1976/1977	1	0	0	19	249	579	717	949	575	287	76	14	0	2515	
1977/1978	2	0	0	4	192	293	640	910	754	456	98	33	0	2430	
1978/1979	16	0	0	1	157	211	576	856	619	126	107	37	1	2887	
1979/1980	12	0	0	14	147	373	609	649	419	157	27	1	0	2724	
1980/1981	9	0	0	1	193	394	631	806	519	425	51	55	0	2175	
1981/1982	17	0	0	20	160	322	688	722	499	269	183	15	1	2819	
1982/1983	15	0	0	15	123	323	426	738	542	435	248	46	3	2449	
MEAN	0	0	0	8.2	123.6	357.3	567.9	642.1	499.2	353.8	112.3	26.4	7	2571.4	
SD	00	00	0	7.83	49.62	79.90	113.66	156.42	119.23	99.85	44.47	18.85	1.73	121.11	
N YRS	52	52	52	52	52	52	52	52	52	52	52	52	52	52	

SOURCE: National Climatic Data Centers, State, Regional and National Monthly and Seasonal Heating Degree Days Weighted by Population.

FIGURE 9.2 Example of Seasonal Heating Degree Days Data, Weighted by Population (Data exists by state and region and for months and seasons)

STATE ALABAMA

STATE COOLING DEGREE DAYS, DIVISIONS WEIGHTED BY 1980 POPULATION
BASE TEMP = 65 DEG F

YEAR	RANK	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1931	10	16	14	7	26	136	437	509	391	436	155	42	29	2200
1932	15	50	55	14	61	168	415	540	484	289	68	0	8	2151
1933	4	45	10	30	37	330	396	442	455	426	115	8	32	2326
1934	6	33	5	25	57	225	441	518	489	296	129	19	2	2239
1935	5	27	11	87	60	241	350	503	510	303	134	13	0	2241
1936	1	14	6	60	14	263	474	509	403	192	126	5	6	2372
1937	21	96	9	18	43	237	441	454	485	254	66	1	3	2109
1938	3	24	32	102	51	219	354	466	502	297	120	11	3	2201
1939	17	35	23	55	36	189	413	481	410	358	124	3	5	2134
1940	44	0	5	26	31	141	354	407	465	251	106	8	11	2105
1941	2	24	3	10	77	262	406	476	473	385	230	6	7	2359
1942	29	13	3	26	59	202	406	490	410	245	108	17	6	1985
1943	7	29	15	22	52	277	500	518	526	228	60	3	3	2233
1944	13	20	35	40	36	250	470	457	441	330	80	8	2	2169
1945	12	20	23	123	85	150	399	462	457	381	74	15	0	2189
1946	33	24	16	77	92	183	333	436	389	245	94	37	11	1937
1947	23	36	2	7	77	172	355	370	502	349	187	4	4	2065
1948	22	6	19	57	109	217	422	487	424	248	56	15	10	2070
1949	14	57	29	26	36	244	381	488	445	245	191	5	7	2154
1950	28	116	10	19	17	286	382	404	380	239	128	1	0	2002
1951	8	25	15	19	30	186	405	493	542	334	127	1	9	2206
1952	16	54	20	23	30	223	522	548	467	231	26	4	2	2150
1953	11	34	13	55	28	285	477	459	443	277	117	5	1	2194
1954	3	25	23	24	115	102	411	549	570	402	111	3	1	2336
1955	24	17	14	58	92	263	248	461	479	359	64	4	3	2062
1956	30	12	30	28	30	260	333	449	466	226	110	4	24	1972
1957	27	32	45	13	74	222	394	453	445	274	36	12	3	2009
1958	36	6	0	13	49	198	385	440	428	303	68	15	1	1906
1959	25	13	14	16	38	249	342	461	472	300	128	3	3	2037
1960	37	17	4	2	57	128	366	494	437	287	104	8	0	1904
1961	52	5	21	45	12	129	266	394	385	290	63	14	4	1628
1962	18	12	38	13	21	326	356	483	472	287	114	1	1	2124
1963	35	5	2	52	82	212	354	397	435	249	122	5	0	1915
1964	19	12	2	23	69	207	398	406	399	292	39	17	4	1868
1965	34	22	6	14	90	246	318	422	412	300	63	22	3	1918
1966	49	7	6	21	50	163	285	495	383	245	58	10	2	1725
1967	53	19	4	57	123	154	338	337	313	152	50	4	11	1562
1968	45	12	1	17	56	158	371	423	450	231	83	1	1	1804
1969	42	14	6	4	57	179	379	500	377	225	88	2	1	1832
1970	31	4	3	19	82	197	307	429	440	375	92	1	7	1956
1971	40	18	5	12	30	113	391	400	395	310	150	4	28	1856
1972	43	33	7	30	52	152	295	387	425	356	79	2	6	1824
1973	32	13	4	66	20	126	354	456	389	348	137	25	1	1939
1974	50	68	8	68	35	220	254	427	391	190	44	4	4	1713
1975	47	30	19	22	24	234	329	396	412	178	91	8	1	1744
1976	54	6	24	51	42	86	285	405	365	216	25	0	0	1505
1977	19	1	4	43	70	227	415	513	466	325	42	12	1	2119
1978	26	1	0	13	53	174	384	486	449	359	65	33	3	2020
1979	51	3	3	31	52	164	308	430	413	236	66	4	1	1711
1980	20	22	2	18	24	181	366	552	520	387	43	3	1	2119
1981	38	4	6	16	102	120	441	510	414	207	60	10	1	1891
1982	41	10	8	50	24	219	332	450	413	223	85	11	14	1839
1983	48	10	5	14	6	140	278	473	497	215	89	5	0	1732
1984	46	5	9	20	26	148	355	403	378	229	179	3	24	1779
MEAN		23.3	13.3	33.9	52.2	200.1	373.6	459.3	441.9	289.1	95.7	8.9	5.8	1997.0
SD		22.29	12.31	25.34	27.64	56.37	61.07	48.75	49.98	66.59	43.96	9.15	7.78	208.08
1985		54	54	54	54	54	54	54	54	54	54	54	54	54

SOURCE: National Climatic Data Center, State, Regional and National Monthly and Seasonal Cooling Degree Days, Weighted by Population.

FIGURE 9.3 Example of Seasonal Cooling Degree Days Data, Weighted by Population (Data exists by state and region and for months and seasons)

**GAS UTILITY INDUSTRY CUSTOMERS, BY STATE AND CLASS OF SERVICE,
AVERAGES, 1983**

(Thousands)

Division and State	Total	Class of Service			
		Residential	Commercial	Industrial	Other
United States	48,881.1	44,893.8	3,678.3	182.2	46.8
New England	1,787.2	1,661.2	133.8	9.8	4.0
Connecticut	421.3	384.0	34.8	2.4	0.1
Maine	15.4	12.3	2.8	0.1	0.0
Massachusetts	1,102.8	1,019.2	75.2	5.1	3.3
New Hampshire	53.6	46.6	6.6	0.1	0.2
Rhode Island	177.9	164.6	12.0	1.3	0.0
Vermont	14.3	14.3	1.5	a	0.5
Middle Atlantic	8,348.8	7,643.7	571.8	22.8	10.5
New Jersey	1,894.2	1,708.3	179.3	6.6	a
New York	3,978.7	3,717.7	242.1	10.2	8.7
Pennsylvania	2,375.9	2,217.7	150.4	6.0	1.8
East North Central	10,966.3	10,118.0	797.1	47.2	3.9
Illinois	1,326.9	1,079.7	248.0	18.4	0.8
Indiana	1,289.6	1,179.1	106.9	4.7	0.5
Michigan	2,503.7	2,329.9	162.9	9.8	0.0
Ohio	2,768.0	2,543.6	195.3	6.5	2.5
Wisconsin	1,078.2	985.2	85.1	7.8	a
West North Central	4,287.6	3,889.4	483.3	13.3	1.6
Iowa	761.6	678.4	81.1	1.8	0.3
Kansas	786.3	690.6	70.7	4.9	0.3
Minnesota	878.8	798.1	76.4	4.0	0.3
Missouri	1,222.7	1,128.2	93.1	0.7	0.7
Nebraska	437.5	396.8	39.2	1.3	0.2
North Dakota	92.6	81.3	11.1	a	a
South Dakota	107.8	95.7	11.6	0.4	a
South Atlantic	4,358.2	3,896.4	342.3	14.2	5.4
Delaware	83.1	77.5	5.3	0.2	0.1
District of Columbia	146.1	131.0	15.0	0.0	0.0
Florida	456.3	416.9	38.1	0.5	0.9
Georgia	1,113.8	1,029.2	79.0	2.3	3.3
Maryland	792.4	754.3	31.1	5.0	0.1
North Carolina	416.4	368.2	45.9	2.2	0.1
South Carolina	312.1	280.1	30.4	1.2	0.4
Virginia	547.0	498.3	45.7	2.4	0.6
West Virginia	391.0	358.9	31.8	0.3	a
East South Central	1,252.3	1,201.8	383.9	6.8	10.1
Alabama	683.3	631.7	47.3	2.0	2.4
Kentucky	642.0	583.0	56.4	1.3	1.4
Mississippi	399.6	380.1	36.5	1.3	1.9
Tennessee	527.3	457.0	63.8	2.1	4.4
West South Central	5,763.6	5,256.9	479.9	23.3	7.5
Arkansas	520.5	460.0	58.7	1.7	0.1
Louisiana	1,006.8	936.3	67.1	2.3	1.2
Oklahoma	867.4	801.8	82.2	3.1	0.3
Texas	3,248.8	3,058.8	267.9	16.2	5.9
Mountain	2,888.1	2,689.7	268.1	7.1	3.2
Arizona	590.3	543.4	44.6	1.8	0.5
Colorado	935.0	835.2	98.2	1.5	0.1
Idaho	112.2	96.5	15.6	0.2	0.0
Montana	187.4	166.4	20.5	0.5	0.1
Nevada	185.1	169.9	15.2	0.1	a
New Mexico	349.3	313.0	31.5	2.4	2.5
Utah	400.3	371.7	28.1	0.5	a
Wyoming	138.4	113.7	14.5	0.2	a
Pacific	8,349.1	7,826.8	483.8	38.9	8.5
Alaska	37.4	30.9	5.7	0.8	0.0
California	7,385.6	7,137.1	799.3	32.8	0.4
Hawaii	32.8	28.9	2.2	1.7	0.0
Oregon	288.6	252.5	35.5	0.6	0.0
Washington	364.7	337.5	44.1	2.9	a

a. Less than .05 thousand.

SOURCE: American Gas Association, Gas Facts.

FIGURE 9.4 Example: Gas Utility Customers, by State and Class of Service Averages, 1983 (in thousands)

1983 AVERAGE ANNUAL GAS CONSUMPTION/UNIT^a

BY REGION

(Mcf)

<u>Region</u>	<u>Single Family</u>	<u>Multi- Family^b</u>	<u>Combined Average^c</u>	<u>Heating Degree Days^d</u>	
				<u>1983</u>	<u>30-year Normal</u>
<u>Northeast</u>					
Heating	101.6	70.9	88.7	5,523	5,765
Baseload	<u>38.4</u>	<u>28.9</u>	<u>34.4</u>		
Total	140.0	99.8	123.1		
<u>North Central</u>					
Heating	91.9	69.0	85.9	6,300	6,381
Baseload	<u>31.7</u>	<u>24.6</u>	<u>30.0</u>		
Total	123.6	93.6	115.9		
<u>South</u>					
Heating	60.4	44.8	57.1	3,215	3,002
Baseload	<u>30.2</u>	<u>26.7</u>	<u>29.5</u>		
Total	90.6	71.5	86.6		
<u>West</u>					
Heating	54.5	29.1	46.9	2,625	2,829
Baseload	<u>25.8</u>	<u>22.6</u>	<u>24.8</u>		
Total	80.3	51.7	71.7		
<u>U.S. Average</u>					
Heating	75.6	52.6	69.0	4,426	4,495
Baseload	<u>31.4</u>	<u>25.5</u>	<u>29.7</u>		
Total	107.0	78.1	98.7		

^aResults for 1983 are based on responses from 156 different markets.

^bWeighted average of dwellings containing 2-4 units and dwellings containing 5 units or more.

^cWeighted by customer and dwelling type.

^dCalendar year heating degree days as reported are then weighted by gas househeating customers (see Appendix 1 for detailed definitions). The 30-year normal are also weighted by gas househeating customers as opposed to total population.

SOURCE: American Gas Association, Gas Househeating Survey.

FIGURE 9.5 Example: Average Annual Gas Consumption per Residential Unit, by Region (million cubic feet)

SIC CODE	DESCRIPTION	U.S. ^{2/}	NORTHEAST	NORTH CENTRAL	SOUTH	WEST
50-51	Wholesale Trade	4.02	5.12	5.12	2.12	2.62
52-59 (excl. 58)	Retail Trade	8.3	9.1	9.3	8.0	6.0
58	Restaurants	7.3	8.7	6.5	6.4	9.1
60-67 (excl. 65)	Finance & Insurance	1.6	1.6	1.6	1.6	1.4
65	Real Estate (not classified residential)	13.1	18.0	12.5	18.5	3.0
70	Hotels & Other Lodging	2.9	1.7	2.7	3.3	4.1
72-79	Services	8.4	7.5	8.4	7.8	10.0
80	Health Services	9.8	7.7	10.2	8.7	12.3
82	Education	12.8	10.1	15.9	10.6	11.6
81, 81, 84	Social Services	1.2	1.3	1.0	1.0	1.7
86	Membership Organizations	4.5	4.5	5.7	4.2	2.4
91-97	Public Administration	5.7	4.6	5.1	6.0	7.7
20-19	Manufacturing (not classified industrial)	9.1	8.5	3.9	17.2	10.5
01-09	Agriculture (not classified industrial)	1.8	0.8	1.6	0.5	5.0
	Other SIC	9.3	10.8	10.3	4.1	12.6

1/ Columns might not sum to 100% due to rounding.

2/ Calculated as a sales-weighted average of percentages attributable to each SIC category across the four regions.

Note: Each entry expresses the corresponding SIC category as a percentage of total regional 1982 commercial sales volumes of the respondents less those volumes reported as "not classified by SIC". Sample sizes, based on the total 1982 volumes reported by the respondents, are: U.S. = 46%; Northeast = 43%; North Central = 47%; South = 41%; West = 55%.

Source: American Gas Association, Commercial Gas Market Survey.

FIGURE 9.6 Example: Commercial Sales of Natural Gas by SIC Code and Region (percentage of total sales)

RV HEATING SYSTEMS

	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>
<u>(FURNACE & WALL FURNACES)</u>	190,470	176,103	109,330	155,671	85,285	142,932	314,601	258,180	315,540	219,240
DIRECT HEATING EQUIPMENT										
<u>WALL FURNACES</u>										
<u>VENTED</u>										
Natural	(1)	(1)	79,950	67,850	107,240	109,660	106,550	109,470	103,930	106,650
LP	(1)	(1)	9,630	12,290	17,690	17,610	17,450	16,310	15,010	15,200
<u>TOTAL</u>	<u>123,230</u>	<u>119,880</u>	<u>89,580</u>	<u>80,140</u>	<u>124,930</u>	<u>127,270</u>	<u>124,000</u>	<u>125,780</u>	<u>118,940</u>	<u>121,850</u>
<u>DIRECT VENT</u>										
Natural	(1)	34,430	31,290	33,900	55,540	50,730	56,340	55,640	51,460	47,270
LP	(1)	14,000	11,770	13,120	18,920	21,000	18,830	17,500	13,470	13,220
<u>TOTAL</u>	<u>58,080</u>	<u>48,430</u>	<u>43,060</u>	<u>47,020</u>	<u>74,460</u>	<u>71,730</u>	<u>75,170</u>	<u>73,140</u>	<u>64,930</u>	<u>60,490</u>
<u>FLOOR FURNACES</u>	20,825	18,775	18,746	10,552	12,240	15,560	18,070	23,400	24,000	33,430
<u>DIRECT HEATING EQUIPMENT (e)</u>										
<u>VENTED CABINET</u>										
CIRCULATORS	77,902	63,542	60,569	76,523	124,305	127,201	159,397	111,575	123,700	174,000
<u>INVERTED BOON</u>										
HEATERS	177,940	139,280	121,155	52,951	89,816	58,497	7,630	74,751	(g)182,700	(g)208,000
<u>ALL OTHERS</u>	(1)	(1)	(1)	3,560	7,812	4,972	7,869	4,987		
(Includes Gas logs & Fireplace Inserts)										
<u>TOTAL DIRECT HEATING EQUIPMENT</u>	<u>455,977</u>	<u>389,907</u>	<u>333,090</u>	<u>270,746</u>	<u>413,363</u>	<u>415,230</u>	<u>392,160</u>	<u>415,623</u>	<u>514,270</u>	<u>567,770</u>

SOURCE: Gas Appliance Manufacturers Association, Statistical Highlights

FIGURE 9.7 Example: Shipments of Gas-fired Direct Heating Equipment, 1975 - 1984

ALL DOWNTOWN

INCOME	TOTAL BUILDING RENTABLE AREA					TOTAL OFFICE RENTABLE AREA				
	22 BLDG 5,788,559 SQ FT					4,898,904 SQ FT				
	DOLLARS SQ FT		MO RANGE		1 BLDG	DOLLAR SQ FT		MO RANGE		1 BLDG
	AVG	MEDIAN	LOW	HIGH		AVG	MEDIAN	LOW	HIGH	
OFFICE AREA	8.52	8.89	5.89	11.94	20	9.42	8.85	6.52	9.44	
RETAIL AREA					12					
OTHER AREA	11.14	4.18	.78	23.30	4					
TOTAL RENT	8.38	8.88	5.80	8.81	21					
MISCELLANEOUS	.38	.23	.08	.42	15					
TOTAL INCOME	8.67	8.21	5.88	10.30	21					
EXPENSE										
CLEANING	.82	.61	.52	.78	22	.87	.85	.58	.78	
REPAIR-MAINT	.89	.83	.71	1.13	22	.86	1.08	.71	1.18	
UTILITIES	1.88	1.60	1.42	1.83	22	1.80	1.84	1.55	2.01	
ROS-CHDS-SEC	.31	.35	.27	.47	21	.31	.35	.27	.47	
ADMINISTRATIVE	.75	.54	.19	1.04	22	.75	.54	.19	1.04	
TOTAL OPER EXP	4.28	4.08	3.78	4.72	22	4.57	4.47	3.85	5.05	
FIXED EXPENSES	1.10	1.05	.87	1.28	20	1.10	1.05	.87	1.28	
TOTAL OPER+FIXED	5.28	4.85	4.64	5.80	22	5.65	4.97	4.68	6.18	
LEASING EXP	.33	.20	.12	.60	18					
TOTAL PAYROLL	.79	.65	.44	.98	18					
TOTAL CONTRACT	1.23	1.10	.87	1.35	17					
AVG SQFT/OPC TEN		5292	22			AVG OFFICE OCCUPANCY		83.4	22	
AVG SQFT RET TEN		2715	7			AVG RETAIL OCCUPANCY		100.0	7	
AVG SQFT/OPC WORK		289	13			AVG RATE YR-END RENT		11.77	21	
						RENTABLE GROSS SQFT		81	18	

COMPONENT COSTS - TOTAL BUILDING RENTABLE AREA - MEDIAN DOLLARS SQFT					
COMPONENT	MEDIAN	BLOS	COMPONENT	MEDIAN	BLOS
CLEANING TOTAL	.81	14	ADMIN TOTAL	.35	14
PAYROLL	.52	4	PAYROLL	.18	13
CONTRACT	.54	12	MAINT FEES	.21	7
SUP-MAT-MISC	.08	10	LEGAL FEES	.02	4
TRASH REMOVAL	.03	13	AUDIT FEES	.02	8
			GEN OFC EXP	.02	7
REPR-MAINT TOTAL	.93	14	OTHER ADM EXP	.02	11
PAYROLL	.41	11			
ELEVATOR	.10	14	FIXED EXP TOTAL	.97	13
HVAC	.12	14	REAL ESTATE TAX	.85	13
ELECTRICAL	.07	11	BUILDING INS	.08	13
STRUCT ROOF	.01	7	PERS PROP TAX	.08	3
PLUMBING	.02	13	OTHER TAXES	.01	5
GEN SUPPLIES	.03	13			
GEN MAINT	.12	14	LEASING EXPENSES	.12	18
			ADV PROMOTION	.00	2
UTILITIES TOTAL	1.58	14	COMM-FEES	.05	6
ELECTRIC	1.32	14	TENANT ALTS	.10	6
GAS	.18	7			
FUEL OIL	.03	2	BUT-OUTS		
PURCH STEAM	.27	2			
PURCH CH WTR			TOTAL PAYROLL	.51	11
COAL			CLEANING	.48	2
WATER-SEWER	.08	14	REPAIR-MAINT	.41	8
			ROS GROUNDS	.15	3
ROS CHDS SEC TOT	.31	13	SECURITY	.22	2
ROS-CHDS TOTAL	.02	11	ADMINISTRATIVE	.12	11
ROS-CHDS PAYRL	.08	2			
ROS-CHDS CONTR	.02	10	TOTAL CONTRACTS	1.08	10
ROS-CHDS OTHER	.01	3	CLEANING	.55	10
SECURITY TOTAL	.32	8	REPAIR-MAINT	.08	7
SEC PAYROLL	.22	2	ROS GROUNDS	.02	7
SEC CONTRACTS	.35	8	SECURITY	.38	8
SEC OTHER	.00	3	ADMINISTRATIVE	.21	5

SOURCE: Building Owners and Managers Association Experience Exchange Report.

FIGURE 9.8 Example: Data from the Experience Exchange Report

YEAR AND MONTH	CONSTRUCTION CONTRACTS (F.W. DODGE DIVISION, BOSTON-NEW YORK) - Total construction value (Millions of dollars, seasonally adjusted)							NEW HOUSES UNITS STARTED (Thousands of units)					
	Total		By ownership		By type of building		NEW CONSTRUCTION PLANNING (Engineering records)	Unimproved lots started		Privately owned		Seasonally adjusted to 1959	
	Millions of dollars	Units, 1957 = 100	Public	Private	Manufacturing	Residential		Total	Unimproved lots started	Privately owned	Seasonally adjusted to 1959	Total	Seasonally adjusted to 1959
	\$	+						\$	+			\$	+
1957	37,135		12,547	24,588	12,115	10,122	8,897	21,788	1,385.0	1,313.0	874.3		
1958	41,303		13,589	27,714	13,010	10,320	10,256	21,186	1,482.3	1,482.3	991.4		
1959	45,546		14,662	30,884	14,377	10,302	10,897	23,238	1,634.6	1,634.6	1,012.2		
1960	47,289		15,371	31,918	15,486	10,381	11,244	44,405	1,561.0	1,561.0	1,070.5		
1961	48,272		16,388	32,884	17,218	11,248	10,808	46,625	1,508.7	1,473.9	1,023.7		
1962	50,189		16,152	34,037	18,388	17,527	12,989	52,112	1,186.8	1,186.8	776.6		
1963	54,514		19,039	35,475	20,138	21,156	13,229	59,844	1,321.9	1,321.9	843.6		
1964	61,732		19,597	42,135	22,513	24,628	14,388	52,419	1,545.4	1,545.4	986.4		
1965	67,448		22,887	44,561	25,841	25,281	18,545	57,184	1,488.5	1,488.5	1,010.5		
1966	68,384		22,846	45,538	24,488	24,857	18,091	65,897	1,488.5	1,433.9	1,023.9		
1967	80,189		23,887	56,301	26,589	34,714	18,889	85,578	2,084.5	2,084.5	1,151.9		
1968	90,879		24,045	66,834	27,021	44,813	19,889	98,591	2,379.5	2,379.5	1,308.2		
1969	98,384	71	26,588	71,796	31,534	48,889	22,074	98,748	2,087.5	2,046.3	1,152.5		
1970	98,888	67	32,089	66,799	33,128	33,957	28,889	97,108	1,388.8	1,377.7	885.1		
1971	98,888	66	32,188	66,699	31,647	31,281	28,781	98,788	1,171.4	1,184.4	882.5		
1972	110,091	70	29,384	80,707	38,028	44,169	38,887	98,487	1,547.6	1,537.9	1,184.4		
1973	130,723	100	38,917	91,806	38,088	68,017	42,889	91,702	2,091.7	1,987.1	1,488.9		
1974	150,889	114	38,917	111,972	48,048	74,848	38,889	112,089	2,088.1	2,088.1	1,488.9		
1975	168,448	122	48,888	119,560	58,889	74,587	48,889	138,889	1,788.8	1,748.1	1,184.1		
1976	148,388	107	41,717	106,671	52,488	68,889	38,889	148,148	1,312.8	1,388.2	882.2		
1981	153,488	110	38,888	114,600	58,889	68,184	38,889	148,388	1,188.3	1,084.3	788.4		
1982	154,818	111	41,347	113,471	58,388	58,078	37,388	148,388	1,072.8	1,088.3	688.3		
1978													
January	11,788	131	2,884	8,904	3,889	4,528	3,288	8,888	88.8	88.2	57.8	1,088	1,118
February	12,888	142	3,478	9,410	3,228	4,988	4,048	11,732	88.8	84.8	58.8	1,588	1,088
March	14,888	127	2,787	11,101	4,158	6,944	3,818	13,788	128.8	152.8	108.8	1,847	1,328
April	16,788	126	3,587	13,201	4,891	7,108	5,318	11,078	181.8	181.8	121.2	1,748	1,287
May	18,488	128	4,584	13,904	4,441	8,084	5,788	14,387	188.8	188.1	131.2	1,878	1,377
June	18,184	116	4,318	13,866	4,884	7,388	5,841	9,288	188.8	181.8	134.8	1,813	1,318
July	18,778	128	4,047	14,731	4,887	8,888	4,388	7,987	188.8	184.2	117.8	1,788	1,188
August	14,288	123	3,178	11,110	4,408	7,078	2,811	10,348	178.8	178.3	118.4	1,778	1,228
September	13,184	118	3,821	9,363	4,478	6,184	2,888	6,087	168.8	168.7	108.7	1,528	1,188
October	12,844	114	3,788	9,056	4,744	6,888	2,388	10,888	188.8	188.8	107.8	1,881	1,118
November	11,732	112	3,888	8,744	3,788	4,784	3,288	14,872	118.3	118.7	72.8	1,584	887
December	10,388	107	2,844	7,544	3,488	4,173	2,737	13,288	88.8	81.8	57.8	1,488	1,048
1989													
January	10,848	131	3,488	7,360	4,278	4,088	2,887	17,184	72.8	72.1	48.8	1,361	888
February	10,188	112	3,024	7,164	3,488	4,388	2,388	12,884	88.8	78.8	48.8	1,388	888
March	10,848	98	3,588	7,260	4,088	4,488	2,388	12,788	88.8	88.1	51.7	1,047	888
April	10,848	81	3,812	7,036	3,888	4,318	2,884	12,387	88.8	88.8	81.8	1,081	888
May	11,484	86	3,578	7,906	4,288	4,418	2,884	12,087	88.8	81.7	88.7	887	888
June	12,884	97	4,088	8,796	4,988	5,087	2,888	8,888	117.7	118.4	78.8	1,188	772
July	13,488	108	3,738	9,750	4,881	6,138	2,388	9,848	121.8	128.1	88.8	1,288	887
August	16,448	123	3,528	12,920	4,288	6,088	5,088	4,887	131.7	128.8	88.8	1,428	888
September	12,088	108	3,821	8,267	4,288	6,288	2,388	9,881	147.8	128.3	88.8	1,471	1,018
October	12,788	114	3,388	9,400	4,874	6,884	2,042	13,388	108.7	102.7	87.8	1,528	1,088
November	12,888	117	3,884	9,004	4,888	5,847	2,082	17,388	112.8	112.8	71.2	1,518	888
December	12,914	138	3,187	9,727	4,471	5,548	2,388	13,871	88.8	88.8	58.8	1,488	888
1991													
January	11,888	128	3,218	8,670	4,088	4,287	3,288	14,881	88.3	84.8	48.8	1,588	871
February	10,187	112	2,888	7,300	3,888	4,187	2,088	12,448	72.3	71.9	48.8	1,278	888
March	12,888	117	3,528	9,360	5,213	5,887	2,511	11,212	108.8	107.8	72.8	1,388	881
April	15,331	123	3,887	11,444	5,288	6,617	3,888	15,548	124.8	123.8	88.8	1,328	888
May	13,288	108	3,391	10,897	5,048	5,888	2,388	14,088	118.8	108.8	72.8	1,188	788
June	14,748	108	3,348	11,400	5,588	5,888	3,418	11,884	107.8	108.8	72.8	1,047	784
July	12,578	108	3,218	9,360	5,587	5,818	2,712	13,887	101.8	88.8	88.8	1,088	888
August	11,888	88	3,228	8,660	5,088	4,728	2,074	11,888	87.3	88.3	57.8	848	614
September	12,724	108	3,818	8,906	5,288	4,704	2,818	11,888	88.8	84.1	58.8	888	687
October	12,842	101	3,488	9,354	5,811	4,718	3,112	18,387	88.2	87.2	48.8	888	518
November	9,878	88	2,344	7,534	4,488	3,848	1,888	15,488	84.8	84.8	48.1	828	548
December	11,888	118	2,811	9,077	4,388	3,677	3,841	17,318	88.7	88.1	34.1	828	548
1992													
January	11,328	118	2,888	8,440	3,888	2,881	4,472	15,888	47.8	47.2	38.3	877	588
February	11,088	118	3,088	8,000	5,788	2,048	2,844	12,108	52.8	51.3	38.8	811	581
March	13,587	118	4,288	9,299	5,888	4,342	3,288	10,844	78.7	78.3	51.8	888	687
April	12,348	84	4,488	7,860	5,884	4,848	3,888	14,848	88.1	84.1	58.8	811	588
May	12,813	84	3,788	9,025	4,128	5,088	3,288	8,118	88.2	88.8	58.8	1,088	888
June	15,444	111	4,388	11,056	6,113	5,888	3,728	8,278	87.2	81.1	88.8	998	817
July	12,328	88	3,744	8,584	5,911	5,144	2,778	11,888	107.3	108.8	81.4	1,188	888
August	13,888	112	3,411	10,477	5,288	5,414	3,888	10,388	97.3	88.8	88.8	1,048	881
September	14,188	117	3,848	10,340	5,228	5,588	3,488	11,888	108.4	108.4	88.3	1,134	888
October	12,548	108	3,272	9,276	5,077	5,888	1,888	13,372	111.8	110.8	88.3	1,148	718
November	12,888	128	3,137	9,751	4,888	5,888	2,791	18,888	108.8	108.8	88.8	1,381	888
December	13,677	131	2,888	10,789	3,878	5,184	4,818	17,888	88.4	88.8	51.8	1,388	842

SOURCE: U.S. Department of Commerce, Business Statistics.

FIGURE 9.2 Example of Data from F.W. Dodge

HEATING AND COOLING

HEATING EQUIPMENT

Please show below the number of houses you built with the following types of heating systems. (Write in number of houses)

1310

☐ No Heating System

Central Systems

1311 ☐ Warm air - electric
1312 ☐ Warm air - gas
1313 ☐ Warm air - oil

1314 ☐ Hot water - electric
1315 ☐ Hot water - gas
1316 ☐ Hot water - oil

1317 ☐ Electric baseboard or radiant ceiling

1318 ☐ Heat pump (See "A" below)

1319 ☐ Solar (See "B" below)

Non-central Systems

1320 ☐ Floor furnace - gas
1321 ☐ Wall furnace - gas
1322 ☐ Other _____

Specify

A. Heat Pumps: Auxiliary Equipment

Was there provision for auxiliary heating along with your heat pumps?

1323

☐ Yes ☐ No

If yes, what percent were installed with:

Electric heaters ☐ 1324
Gas furnaces ☐ 1325
Oil furnaces ☐ 1326
Solar ☐ 1327

100%

Were your heat pumps equipped with an auxiliary heat exchanger for the supply of domestic hot water?

1328

☐ Yes ☐ No

B. Solar Energy Space Heating

1329

Approximate square feet of collector
Square feet

Type of Collector (Check one) Back-up Fuel (Check one)

1330

☐ Air
☐ Liquid

1331

☐ Gas
☐ Electric
☐ Oil

WATER HEATER FUEL

How was your water heater typically fueled?

1332

☐ Gas ☐ Oil
☐ Electric ☐ Other

COOLING EQUIPMENT

(Write in number of houses)

1333

☐ No Cooling Equipment

Central Air Conditioning Systems

1334

☐ Heat pump

1335

☐ Condenser (See below)

1336

☐ Evaporative cooler

1337

☐ Other _____

Specify

Non-central Cooling Units

1338

☐ Room air conditioners

1339

☐ Other _____

Specify

Type of Cooling Fuel (Check one)

1340

☐ Gas

☐ Electric

Condensers

What percent were:

Split systems (condenser outside,
coil or fan coil inside)

☐ 1341

Self-contained packages

☐ 1342

100%

SOLAR WATER HEATING OR SOLAR ASSISTED WATER HEATING

How many houses?

1343

Number of houses

1344

Approximate square feet of collector
Square feet

Type of Collector

What type of collector did the system use?
(Check one)

1345

☐ Air

☐ Liquid

Back-Up Fuel

What was the primary back-up fuel?
(Check one)

1346

☐ Gas

☐ Electric

☐ Oil

SOURCE: NAHB Research Foundation Survey Form for Builders of Single Family Detached Homes

FIGURE 9.10 NAHB Research Foundation Survey Form

Source: Busch et al, LBL-18306

FIGURE 9.11 Energy Performance of BECA-A Buildings

In Figure 9.11, Annual furnace output is graphed versus degree-days (base 13°C or 55.4°F) for 227 low-energy houses in the BECA-A database. The solid line is a least-squares fit of the computer-simulated loads of homes with average thermal characteristics, as determined by a 1980 NAHB survey. The degree-day scale is a proxy for climatic severity; the reference temperature of 55.4°F represents the average balance temperature for buildings in the database.

Remarks:

1. Almost all of the homes in the BECA-A database fall below our baseline representing current building practice. Variability in performance is high, especially in colder climates.

Source: Goldman, LBL-17926.

FIGURE 9.12 Range of Fuel Savings Among Households

In Figure 9.12, the range in annual fuel savings among selected households is in the same location that installed similar conservation measures, based on 15 retrofit projects in the BECA-B database.

Remarks:

1. The spread in energy savings among homes found between the first and third quartile (i.e., the middle 50% of the sample) is typically $\pm 35\%$ of the median savings. The variance in savings is due mainly to differences in occupant behavior, physical differences among houses prior to retrofit, and variations in product and installation quality.
2. Energy savings for a given measure appear to be more variable in mild than in harsh climates.

FIGURE 9.13 Annual Site Energy Intensities

Figure 9.13 shows the annual site energy intensities for groupings of 103 office buildings and 21 schools in the BECA-CN database. Maximum, minimum, average, and median values, and standard deviations are shown for each data subset. ASHRAE Standard 90 simulation estimates, and NBECS averages for the U.S. stock (1979) are plotted for comparison.

Source: Gardiner et al, LBL-17881.

FIGURE 9.14 Distribution of Site Energy Savings

Figure 9.14 gives the Distribution of site energy savings for buildings in BECA-CR database.

Remarks:

1. For those buildings that saved energy, the average change in energy intensity is 45.3 kBtu/ft²-yr; median savings is 30.8 kBtu/ft²-yr. Nineteen of the buildings used more energy after retrofit than before, either due to "failed" measures or to factors other than retrofit performance.

Source: Gardiner et al, LBL-17881.

FIGURE 9.15 Distributions of Simple Payback Time

In Figure 9.15, distribution of simple payback time for buildings in BECA-CR database is provided.

Remarks:

1. Roughly 50% of the retrofitted commercial buildings had paybacks of less than one year; over 80% had payback periods under three years. Paybacks are calculated using 1983 national average fuel prices.
2. Investment strategies are quite conservative; the median retrofit cost is \$0.40/ft², about equal to 4-6 months' energy costs (not shown in this figure).

Source: Wagner et al, LBL-17884.

FIGURE 9.16 Predicted vs. Actual Performance in Energy Savings

Predicted versus actual performance for groups of unoccupied buildings, residential buildings that were retrofitted, and new commercial buildings are shown in Figure 9.16. Actual versus audit predictions for retrofitted commercial buildings is also shown.

Remarks:

1. Prediction quality is more a function of input data than of model sophistication. Research studies designed for model validation show that most model predictions based on hourly simulation and detailed building characteristics are within ± 20 percent of the measured values. Factors that influence predictive accuracy are: the quality and detail (e.g., time periods) of measured data, the model-user's skill, and the choice of default values used to reflect occupant behavior.
2. Data quality limitations are more serious when models are used by practitioners, either for new design or retrofit (Figs. 7B to 7D). Predictions tend to underestimate actual energy use, and overestimate retrofit savings. There appears to be more scatter in predicting performance of new, commercial buildings.

9.3 Overview of Building Energy Use and Report of Analyses

In October 1985, Brookhaven National Laboratory prepared the first in a series of annual reports entitled, Overview of Building Energy Use and Report of Analyses. The main objectives for this series of annual reports are to (1) provide a consistent source of historical data on energy consumption patterns, prices, and building characteristics for use as input to BCS's R&D and program planning; (2) document BCS's Disaggregate Projection of residential and commercial energy consumption; and (3) summarize selected BCS analysis activities.

The data provided in the Overview of Building Energy Use and Report of Analyses-1985 (Overview) is a summary of pertinent information on energy consumption in the buildings sector. Those needing more detailed information or documentation of the information contained in the Overview are requested to refer to the Buildings and Community Systems Data Book. Table 9.6 provides a crosswalk between the Table and figures contained in the Overview and similar information contained in the Buildings and Community Systems Data Book.

TABLE 9.5
Crosswalk Between the Overview of Building
 Energy Use and Report of Analyses - 1985 and the 1986
 Buildings and Community Systems Data Book

<u>Overview of Building Energy Use and Report of Analyses - 1985</u>			<u>BCS Data Book</u>
Figure Number	Title	Page Number	Page Number
2.1	U.S. Primary Energy Consumption	7	1.2
2.2	Household Growth and Primary Energy Consumption	8	6.2
2.3	Floorspace Growth and Primary Energy Consumption	9	8.3
2.4	Primary Energy Consumption per Household	10	6.6
2.5	Primary Energy Consumption per Square Foot of Commercial Floorspace	10	N/A
2.6	Residential End-Use Consumption by Fuel Type	11	6.3
2.7	Commercial End-Use Consumption by Fuel Type	12	8.10
2.8	Residential Sector Prices (Current \$)	15	N/A
2.9	Residential Sector Prices (1984 \$)	15	6.12
2.10	Commercial Sector Prices (Current \$)	16	8.17
2.11	Commercial Sector Prices (1984 \$)	16	8.17
2.12	Space Heating Fuel Type - Single-Family Homes	18	3.11
2.13	Space Heating Fuel Type - Multi-Family Homes	18	4.21

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Figure Number	Title	Page Number	Page Number
2.14	Residential Sector Installation of Air Conditioning Equipment	19	4.28
2.15	Number of Commercial Buildings by Building Type	23	7.3
2.16	Area of Commercial Floorspace by Building Type	23	7.2
2.17	Commercial Sector Heating Fuel	24	7.16
2.18	Commercial Sector Heating Equipment	25	7.2
2.19	Commercial Sector Air Conditioning Equipment	26	7.28
4.1	Range of Fuel Savings Among Households	47	9.38
4.2	Site Energy Intensity	48	9.39

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Table Number	Title	Page Number	Page Number
2.1	Primary Energy Consumption by fuel type, Residential & Commercial Sectors	13	N/A
2.2	Residential Sector House Heating Fuel By Housing Type	17	2.4
2.3	Air Conditioning Equipment by Housing Type	20	2.16
2.4	Household Appliance Saturation Levels	21	5.2
2.5	Shipment Weighted Energy Factors	22	5.6
3.1	Disaggregate Forecast: Commercial Consumption	34	N/A
3.2	Disaggregate Forecast: Commercial Consumption	35	N/A
3.3	Disaggregate Forecast: Energy Consumption by Fuel Type	36	N/A
3.4	Primary Energy Use by End-Use	37	N/A
3.5	Comparison of Forecast of Energy Consumption	38	N/A
3.6	Comparison of Forecast of Energy Consumption by Steel Type	39	N/A
3.7	Comparison of Assumptions for the Year 2000	40	N/A
3.8	Comparison of Forecast of Energy Intensities	41	N/A

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