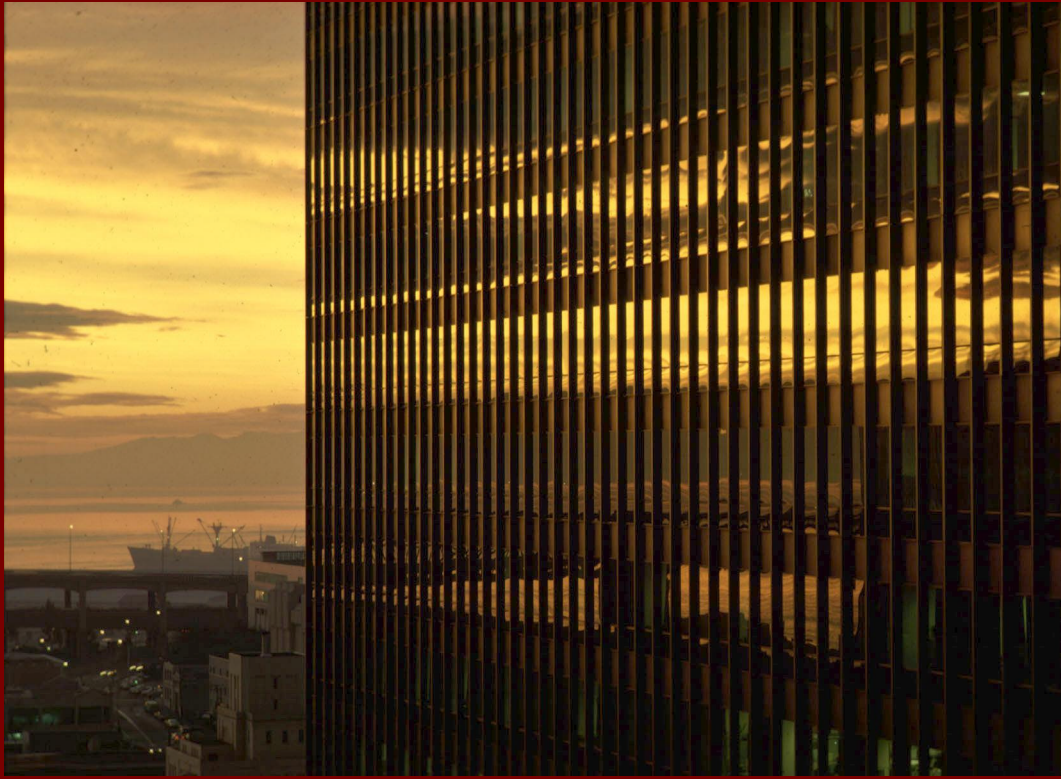


PACIFIC GAS AND ELECTRIC COMPANY



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# Commercial Building Survey Report

SEPTEMBER 1997



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# 1. Executive Summary

The Commercial Building Survey was a data collection effort involving the on-site survey of over 2,000 commercial customers chosen to represent the population of commercial buildings in the PG&E service territory. This survey collected information about the customers' building structures, business operations, equipment types, fuel choices, and operating schedules. This information, along with billing data and other available customer information, was further analyzed to produce simulated end-use intensities and simulated end-use sales. Data in this

report were collected during the calendar years 1993 and 1994.

The goal of this effort was to provide a more current and robust data resource for understanding our customers and their energy usage and needs. This report details the methodology and major findings of this effort in order to expand the audience for and use of this vital data on commercial customers and to provide a common reference point for PG&E-specific data for further analysis.

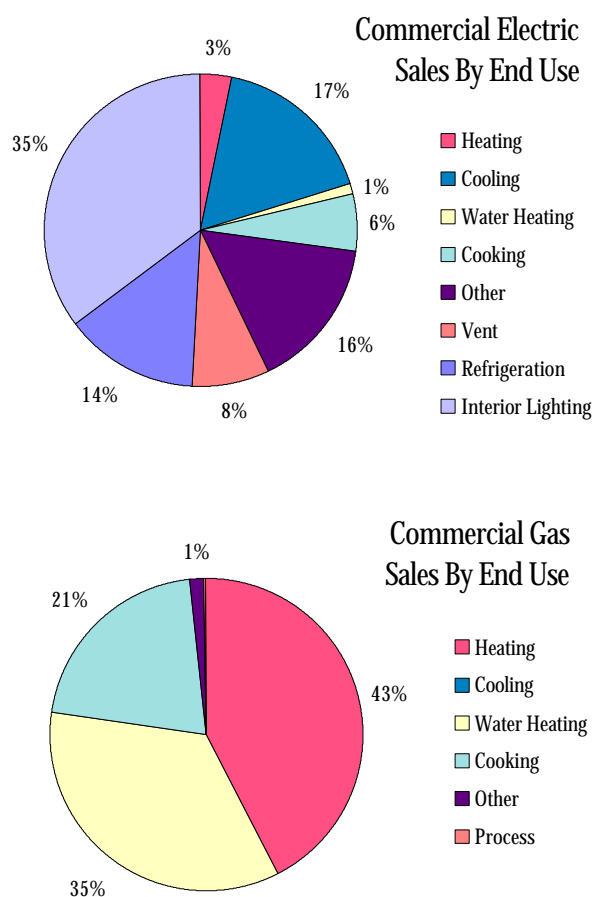
## Major Findings

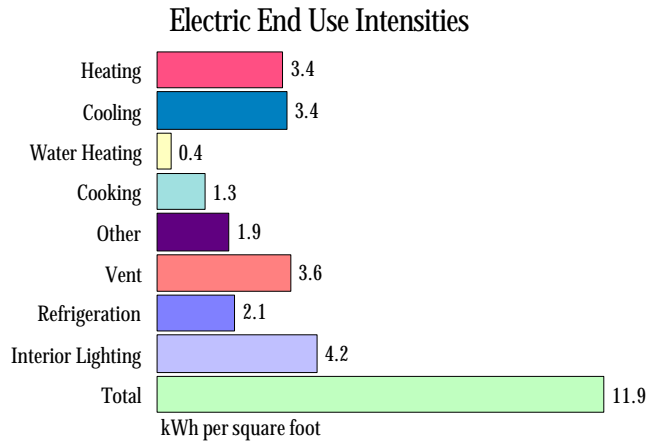
The average commercial premise in PG&E's service territory occupied approximately 6,700 square feet of space. However, about 75% of commercial premises were less than 5,000 square feet. Of the 2.1 billion square feet of commercial space in PG&E's service territory, all used electricity, 84% used gas, and 7% used LPG. Approximately 63% of commercial square footage was owned by the primary tenant, with the remainder renting or leasing. Fifty-four percent of commercial square footage was built since 1970 and 32% since 1980. Seventy-one percent of commercial square footage was heated and 58% cooled. In comparison, 76% of commercial premises had space heating capacity and 67% cooling capacity.

Interior lighting accounted for approximately 35% of total commercial electric sales, followed by cooling at 17%, other at 16%, and refrigeration at 14%. Heating was the largest gas end use, accounting for 43% of commercial gas sales. Water heating and cooking accounted for 35% and 21% of annual gas sales, respectively.

Figure 1 shows how commercial sales were divided into the major end uses.

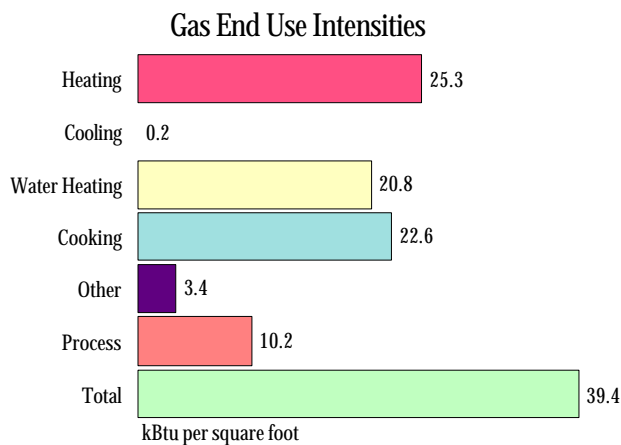
Figure 1 - Annual Sales by End Use



*Figure 2 - End-Use Intensities*

The average commercial premise used 12 kWh per square foot per year, while the average commercial gas premise used 39 kBtu per square foot per year. Interior lighting had the highest annual electric end-use intensity for commercial premises at 4.2 kWh per square foot, followed by ventilation, cooling and heating at 3.6, 3.4, and 3.4 kWh per square foot respectively. Heating had the highest annual gas end-use intensity at 25.3 kBtu per square foot, followed by cooking at 22.6 and water heating at 20.8 kBtu per square foot.

Figure 2 provides the commercial annual end-use intensities for electricity and gas.





## 2. Building Construction and Characteristics

### Square Footage

There were approximately 319,000 premises comprising 2.14 billion square feet of commercial space in PG&E's electric and gas service territories. This represented an increase of 48% from the 1982 Commercial Energy Use Survey (CEUS) estimate of 215,400 premises and 19% over the previous estimate of 1.8 billion square feet. The average premise, at approximately 6,700 square feet, represented a decrease of 20% from the 1982 estimate of 8,400 square feet. This shows a disproportionate increase in the number of smaller commercial customers from 1982 to 1993.

Table 1 shows estimates of square footage and the number of premises by business type and climate zone for the electric, gas, and combined PG&E service territories. Offices accounted for 29% of commercial floor space, more than twice as much as any other business type. Colleges had the largest average premise size at 34,800 square feet, followed by hotels and motels at 34,000 and schools at 33,700 square feet. Restaurants and retail stores had the smallest average premise size at 2,700 and 2,800 square feet, respectively.

*Table 1 - Square Footage and Number of Premises*

	<i>Electric Customers</i>		<i>Gas Customers</i>		<i>Total PG&amp;E Customers</i>		<i>Average square feet</i>
	<i>Thousands of square feet</i>	<i>Customers</i>	<i>Thousands of square feet</i>	<i>Customers</i>	<i>Thousands of square feet</i>	<i>Customers</i>	
Colleges	33,730	900	40,040	1,000	42,250	1,200	34,800
Food Stores	58,230	13,200	42,540	7,000	58,440	13,400	4,400
Hospitals	63,160	2,300	78,420	2,900	84,310	3,500	23,800
Hotels, Motels	110,320	4,900	140,110	2,500	169,380	5,000	34,000
Miscellaneous	263,770	39,100	150,700	15,100	298,580	39,800	7,500
Offices	555,060	94,100	485,950	48,300	623,250	97,400	6,400
Refrig Warehouses	45,640	3,500	7,200	200	45,640	3,500	12,900
Restaurants	56,260	21,800	61,590	20,500	72,270	26,900	2,700
Retail Stores	256,400	94,700	180,460	35,400	274,530	99,700	2,800
Schools	152,950	5,000	155,890	3,100	197,920	5,900	33,700
Warehouses	269,230	22,700	130,970	10,100	273,120	22,700	12,000
Desert/Mountain	295,940	52,600	126,010	20,700	296,570	52,600	5,600
Valley	290,350	60,800	409,920	33,300	512,190	71,400	7,200
Coastal	632,170	89,000	418,410	31,400	646,550	89,500	7,200
Hill	646,290	100,000	519,530	60,600	684,390	105,500	6,500
Total	1,864,750	302,300	1,473,860	146,000	2,139,690	319,000	6,700

Table 2 shows the combined gas and electric square footage by climate zone for each business type.

Table 3 provides an estimate of the percent of premises by square footage by business type and climate zone. Although refrigerated warehouses occupied an average of 12,900 square feet, they had

the largest percentage of premises under 1,000 square feet (43%) and tie with schools for the largest percentage of premises over 50,000 square feet (17%). This implies that there were a number of very small refrigerated warehouses, but the mean was driven higher by a few much larger premises.

*Table 2 - Square Footage (thousand) by Business Type and Climate*

	Desert/Mountain (very hot)	Valley (hot)	Coastal (cool)	Hill (moderate)	Total
Colleges	12,070	9,830	4,180	16,170	42,250
Food Stores	11,530	12,020	17,810	17,080	58,440
Hospitals	9,970	21,380	26,850	26,120	84,310
Hotels, Motels	19,470	64,830	49,690	35,400	169,380
Miscellaneous	57,610	54,510	110,180	76,280	298,580
Offices	49,130	140,940	221,020	212,160	623,250
Refrig Warehouses	27,720	1,320	7,250	9,350	45,640
Restaurants	9,100	18,330	18,630	26,210	72,270
Retail Stores	39,000	61,310	68,790	105,430	274,530
Schools	33,020	65,970	30,090	68,830	197,920
Warehouses	27,950	61,760	92,050	91,360	273,120
Total	296,570	512,190	646,550	684,390	2,139,690

*Table 3 - Percent of Business Type and Climate by Square Footage*

	0– 1,000	1,001– 2,000	2,001– 5,000	5,001– 10,000	10,001– 25,000	25,001– 50,000	50,001– 100,000	100,001 & Up
Colleges	13%	26%	13%	0%	9%	33%	2%	4%
Food Stores	16%	34%	32%	8%	5%	4%	1%	0%
Hospitals	6%	25%	0%	12%	23%	28%	2%	5%
Hotels, Motels	13%	2%	11%	23%	30%	14%	3%	4%
Miscellaneous	12%	27%	32%	13%	7%	6%	2%	1%
Offices	22%	29%	24%	13%	7%	2%	2%	1%
Refrig Warehouses	43%	4%	5%	3%	24%	3%	16%	1%
Restaurants	23%	33%	35%	7%	1%	0%	0%	0%
Retail Stores	36%	33%	21%	5%	3%	1%	1%	0%
Schools	8%	2%	13%	4%	12%	45%	11%	6%
Warehouses	5%	15%	21%	20%	25%	7%	4%	3%
Desert/Mountain	13%	26%	32%	20%	3%	3%	3%	1%
Valley	25%	32%	22%	9%	5%	3%	2%	1%
Coastal	26%	25%	21%	9%	12%	5%	1%	1%
Hill	24%	29%	25%	7%	7%	5%	1%	1%
Total	23%	28%	24%	10%	7%	4%	2%	1%

### **Fuels Used at Premise**

All commercial premises in PG&E's service territory used electricity. About 209,800 premises used gas, while 25,000 used LPG, and 8,700 premises used an alternate fuel—solar, wind, wood, or other. Table 4 shows the number of premises that used each fuel type by business type and climate.

The number of gas customers in Table 4 is larger than the number reported in Table 1, because Table 1 defines gas premises as any premise with annual gas usage data. This definition limits the sample to only those customers with PG&E gas accounts. Table 4 defines a gas premise as any premise that uses natural gas. This takes into account those gas premises who were not PG&E gas customers, and those who received shared service and had no gas account.

Whereas retail stores made up 31% of commercial premises, they accounted for 44% of premises using LPG and 50% of premises using alternate fuels. The schools sampled in this survey did not use LPG or alternate fuels.

Table 5 provides an estimate of the percent of square footage by business type and climate using fuels on the premise. Warehouses and refrigerated warehouses had the smallest percentage of square footage using gas on the premise at 57% and 69%, respectively. About 22% of the miscellaneous category's floor space used LPG as a fuel. This percentage was more than three times higher than that for warehouses, the next highest LPG user at 7%. Approximately 26% of college floor space had an alternate fuel being used on the premise.

### **Ownership of Premises**

Thirty-nine percent of commercial premises were owned by the primary occupant, with the remainder rented or leased. This was a slight decrease in the ownership of premises by the primary occupant from the 1982 CEUS Survey result of 44%. Sixty-three percent of commercial square footage was owned by the primary occupant, which mirrors the 1982 CEUS Survey result of 64%.

*Table 4 - Fuels Used at Premise*

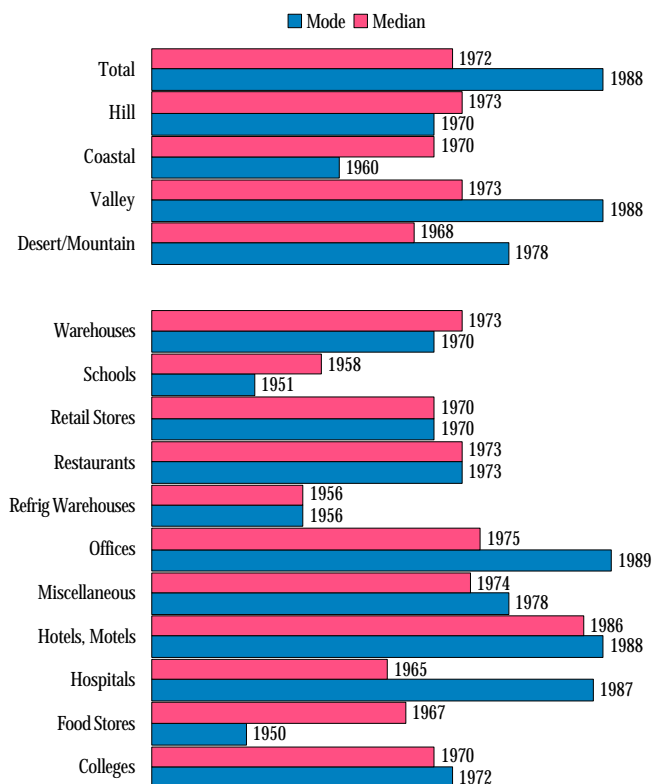
	Electric	Gas	LPG	Other
Colleges	1,200	1,100		100
Food Stores	13,400	8,600	800	300
Hospitals	3,500	3,500	100	100
Hotels, Motels	5,000	4,200	900	500
Miscellaneous	39,800	23,700	3,600	1,700
Offices	97,400	72,000	5,900	1,200
Refrig Warehouses	3,500	1,000	100	<100
Restaurants	26,900	25,100	2,000	200
Retail Stores	99,700	54,500	11,000	4,400
Schools	5,900	4,600		
Warehouses	22,700	11,600	600	400
Desert/Mountain	52,600	36,000	5,200	3,000
Valley	71,400	44,300	6,000	3,500
Coastal	89,500	50,100	6,700	2,000
Hill	105,500	79,300	7,100	200
Total	319,000	209,800	25,000	8,700

*Table 5 - Percent of Square Footage Using Fuel at Premise*

	Electric	Gas	LPG	Other
Colleges	100%	100%	0%	26%
Food Stores	100%	85%	4%	10%
Hospitals	100%	98%	4%	13%
Hotels, Motels	100%	98%	5%	8%
Miscellaneous	100%	70%	22%	1%
Offices	100%	90%	6%	4%
Refrig Warehouses	100%	69%	3%	3%
Restaurants	100%	96%	5%	1%
Retail Stores	100%	83%	3%	2%
Schools	100%	98%	0%	0%
Warehouses	100%	57%	7%	4%
Desert/Mountain	100%	80%	9%	8%
Valley	100%	85%	5%	1%
Coastal	100%	81%	8%	5%
Hill	100%	87%	6%	4%
Total	100%	84%	7%	4%

**Table 6 - Ownership of Premises**

	Percent of Premises		Percent of Square Footage	
	Own	Rent/ Lease	Own	Rent/ Lease
Colleges	59%	41%	96%	4%
Food Stores	40%	60%	31%	68%
Hospitals	54%	46%	79%	19%
Hotels, Motels	99%	1%	65%	35%
Miscellaneous	43%	57%	64%	36%
Offices	48%	52%	70%	29%
Refrig Warehouses	80%	20%	77%	22%
Restaurants	23%	77%	34%	66%
Retail Stores	24%	76%	33%	67%
Schools	93%	7%	93%	6%
Warehouses	38%	62%	52%	47%
Desert/Mountain	54%	46%	79%	21%
Valley	37%	64%	56%	44%
Coastal	37%	63%	65%	35%
Hill	34%	66%	59%	41%
Total	39%	61%	63%	37%

**Figure 3 - Median and Mode of the Year of Construction**

Colleges owned 59% of their premises, which accounted for 96% of their square footage. This shows that while colleges owned the vast majority of their spatial requirements, they rented or leased numerous smaller premises to supplement their needs. In contrast, hotels and motels owned 99% of the premises, which accounted for only 65% of their floor space. This shows that a few very large leased premises accounted for a third of hotel and motel floor space. Table 6 provides more detail on premise ownership.

### **Year of Construction**

Half of PG&E's commercial customers' square footage was constructed before 1972 and half after, making 1972 the median year of construction. More square footage was constructed in 1988—the mode year of construction—than in any other single year. Figure 3 provides a comparison of the median and mode of the year of construction for commercial square footage by business type and climate zone.

Twenty-three percent of commercial premises were constructed during the 80's, the largest percentage of any decade. Colleges had the largest percentage of premises constructed prior to 1940 at 30%. Conversely, 47% of refrigerated warehouses were constructed after 1985. Table 7 shows the percent of premises by construction year by business type and climate zone.

Table 8 displays the percent of total square footage by construction year by business type and climate zone. Twenty-seven percent of commercial floor space was constructed in the 1980's. There was a significant amount of college floor space constructed before 1940—37%—and in the early 1970's—51%. Fifty-nine percent of the square footage for refrigerated warehouses was constructed in the 1950's, with only 6% of square footage built after 1985. However, 47% of refrigerated warehouses premises were constructed after 1985, demonstrating that they are much smaller on average than the existing stock. Conversely, 34% of hotel and motel premises were constructed since 1980. These premises accounted for 68% of hotel and motel floor space, indicating that newer premises are on average much larger than the older.

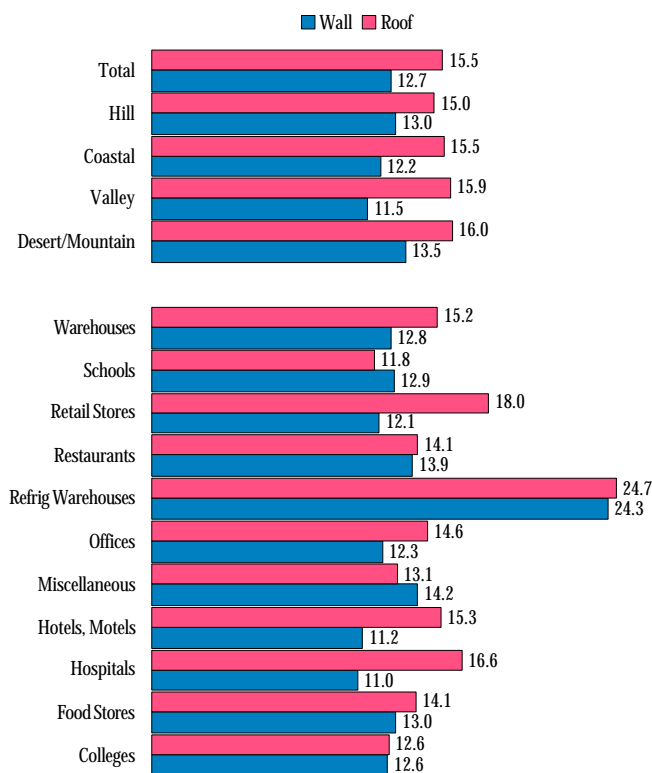
*Table 7 - Percent of Premises by Year of Construction*

	No data	Pre 1940's	1940's	1950's	1960's	1970– 1974	1975– 1979	1980– 1984	1985– 1989	1990's
Colleges	0%	30%	0%	9%	11%	16%	7%	13%	15%	0%
Food Stores	3%	5%	7%	23%	14%	11%	14%	9%	10%	4%
Hospitals	0%	2%	0%	23%	29%	4%	2%	8%	29%	2%
Hotels, Motels	0%	22%	1%	10%	14%	16%	4%	18%	13%	3%
Miscellaneous	3%	11%	2%	30%	11%	12%	6%	14%	5%	6%
Offices	7%	8%	6%	7%	24%	8%	11%	9%	14%	7%
Refrig Warehouses	0%	0%	4%	19%	3%	3%	5%	19%	47%	0%
Restaurants	2%	16%	4%	7%	11%	19%	7%	12%	17%	4%
Retail Stores	6%	18%	8%	8%	17%	15%	6%	11%	8%	3%
Schools	0%	8%	7%	31%	22%	5%	11%	8%	6%	2%
Warehouses	2%	11%	5%	8%	22%	12%	9%	11%	20%	0%
Desert/Mountain	0%	18%	4%	16%	17%	11%	6%	11%	15%	3%
Valley	8%	10%	7%	6%	14%	10%	12%	14%	12%	8%
Coastal	2%	21%	10%	12%	20%	13%	5%	9%	5%	4%
Hill	7%	5%	2%	13%	20%	14%	9%	11%	16%	4%
Total	5%	13%	6%	12%	18%	12%	8%	11%	12%	5%

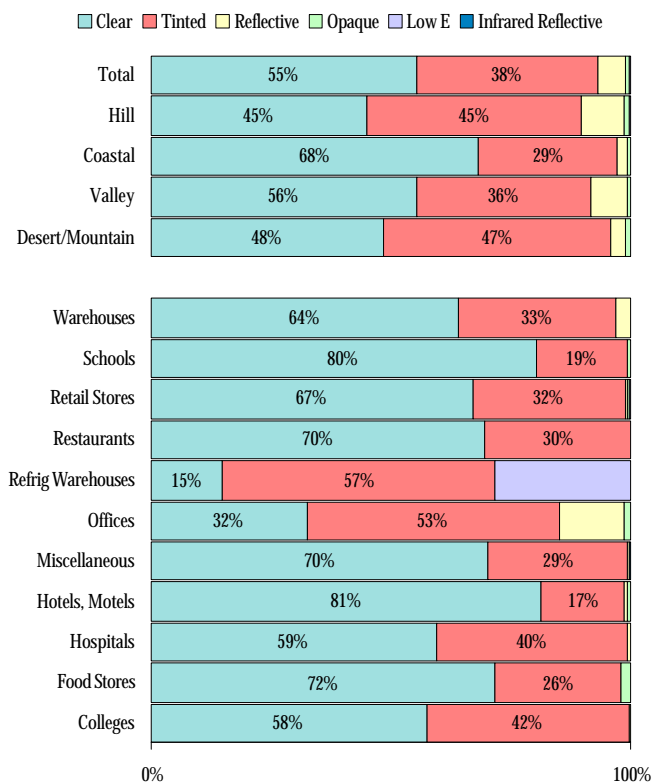
*Table 8 - Percent of Square Footage by Year of Construction*

	Blank	Pre 1940's	1940's	1950's	1960's	1970– 1974	1975– 1979	1980– 1984	1985– 1989	1990's
Colleges	0%	37%	0%	2%	4%	51%	0%	0%	4%	0%
Food Stores	6%	5%	4%	16%	23%	8%	7%	10%	11%	8%
Hospitals	0%	18%	0%	19%	25%	13%	4%	3%	12%	4%
Hotels, Motels	0%	4%	0%	2%	15%	6%	3%	13%	51%	4%
Miscellaneous	2%	14%	5%	17%	8%	9%	19%	14%	6%	8%
Offices	4%	12%	2%	7%	16%	9%	10%	14%	21%	4%
Refrig Warehouses	1%	0%	3%	59%	8%	4%	2%	17%	5%	1%
Restaurants	2%	14%	5%	6%	12%	22%	8%	10%	17%	5%
Retail Stores	2%	8%	5%	9%	22%	16%	11%	9%	11%	8%
Schools	0%	9%	10%	38%	24%	8%	6%	1%	2%	2%
Warehouses	1%	5%	6%	8%	15%	19%	13%	14%	18%	1%
Desert/Mountain	0%	16%	6%	18%	14%	7%	16%	8%	10%	5%
Valley	3%	5%	4%	17%	16%	14%	7%	5%	26%	4%
Coastal	1%	18%	6%	8%	17%	11%	12%	12%	11%	5%
Hill	3%	4%	1%	13%	16%	14%	9%	17%	18%	5%
Total	2%	10%	4%	13%	16%	12%	10%	11%	16%	5%

**Figure 4 - R-Value of Insulating Material of Exterior Walls and Roof**



**Figure 5 - Window Treatment**



## General Construction

### Insulation

The average square foot of PG&E's commercial customers' walls had an insulation R-Value of 12.7, while the average square foot of roof had an insulation R-value of 15.5. Figure 4 highlights the estimates of insulation R-Value by business type and climate zone.

As one might expect, refrigerated warehouses had the highest insulation R-values of 24.7 for the roof and 24.3 for the wall. These values were significantly higher than those for any other business type, demonstrating the importance of cooling energy conservation for refrigerated warehouses. Hospitals and hotels and motels had the lowest wall insulation R-values at 11.0 and 11.2, respectively, but the third and fourth highest roof insulation R-value at 16.6 and 15.3, respectively.

### Window Treatment

Fifty-five percent of the total window square footage in PG&E's commercial class had no window treatment. Thirty-eight percent was tinted, while 6% had a reflective tint. Approximately 1% of window square footage had either infrared reflective, opaque, or low-E treatment.

Eighty-five percent of the window square footage in refrigerated warehouses had energy saving glazing, made up of 57% tinted and 29% low-E. Sixty-eight percent of the window surface area of offices was glazed—53% tinted and 14% reflective. Hotels and motels and schools had the highest percentage of untreated window square footage at 81% and 80%, respectively.

Figure 5 shows the percentage of window square footage by glazing type by business type and climate zone.

### 3. End Uses

#### Space Conditioning

Seventy-one percent of PG&E's commercial customers' square footage was heated, while 58% was cooled. Figure 6 shows the percentage of floor space heated or cooled by business type and climate zone.

Schools, colleges, and hospitals had the largest percentage of floor space heated at 97%, 97%, and 96% respectively. Hospitals, colleges, and restaurants had the largest percentage of floor space cooled at 82%, 79% and 76% respectively. Refrigerated warehouses had the smallest percentage of square footage heated or cooled at 7% and 15%, respectively.

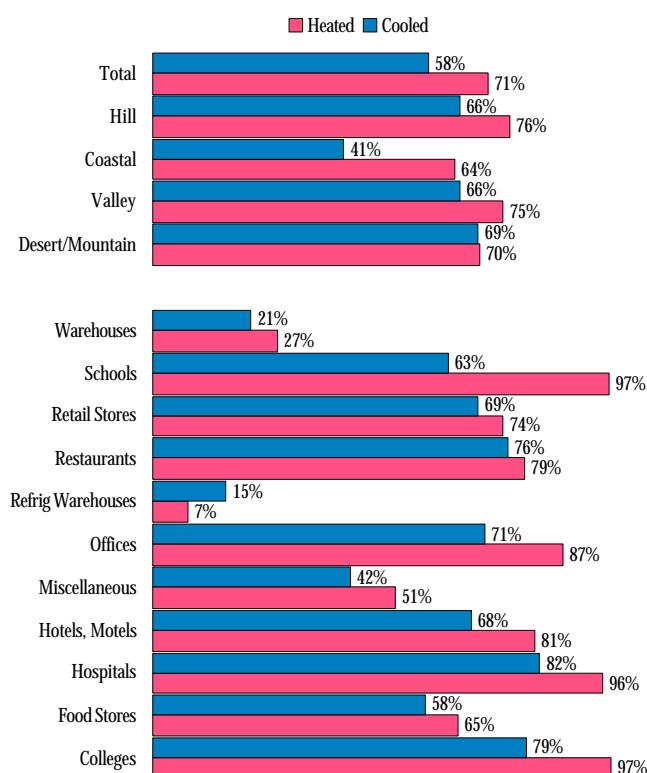
Seventy-six of PG&E's commercial premises were heated. This represents a decrease from the 1982 CEUS estimate of 86%. The percent of premises cooled rose to 67% from 60% in 1982. Hospitals had the largest percentage of premises heated and cooled at 99% and 82% respectively. The coastal climate zone had by far the smallest percent of premises cooled or heated at 34% and 58%, respectively. This reflects the moderate temperatures in this climate zone.

Figure 7 shows the percentage of premises partially or fully heated or cooled by business type and climate zone.

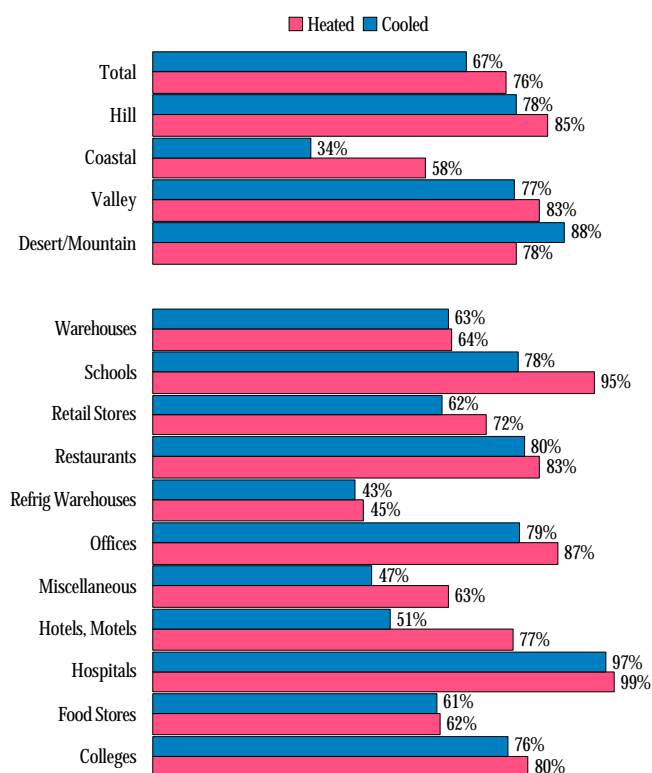
#### Heating

Packaged gas heating equipment made up 45% of the installed heating capacity, followed by built-up gas at 39% and packaged electric at 13%. Built-up electric, built-up other, and packaged other heating equipment accounted for about 3% of total heating capacity. Forty-eight percent of hotels and motels' heating capacity was packaged electric. Colleges, which are fairly likely to utilizing an alternate fuel (fuel other than electricity, gas, or LPG; see Table 4), used only electricity or gas for heating. Refrigerated warehouses, as one may expect from Figure 6, had very little heating capacity, all of which was of the packaged variety.

*Figure 6 - Percent of Square Footage Heated or Cooled*



*Figure 7 - Percent of Premises Heated or Cooled*



*Table 9 - Heating Capacity (million Btu/h)*

	Built-up Electric	Built-up Gas	Built-up Other	Packaged Electric	Packaged Gas	Packaged Other	Total
Colleges	1	1,720		332	195		2,248
Food Stores	19	98	56	186	507	17	882
Hospitals		2,439	346	143	1,133	2	4,063
Hotels, Motels	94	864	28	1,719	813	43	3,561
Miscellaneous	4	3,051	26	501	3,091	5	6,678
Offices	37	8,419	470	1,789	7,712	630	19,058
Refrig Warehouses				46	49		95
Restaurants		76		528	2,419	33	3,055
Retail Stores	28	1,077	41	971	4,343	56	6,516
Schools	5	4,339		855	3,653		8,843
Warehouses		242		498	1,636	39	2,415
Desert/Mountain	21	3,083	144	1,205	4,964	299	9,716
Valley	7	6,043	77	2,847	5,655	372	15,001
Coastal	59	7,270	489	1,132	5,271	40	14,253
Hill	101	5,928	256	2,384	9,660	114	18,443
Total	188	22,324	967	7,567	25,551	825	57,413

*Table 10 - Percent of Premises with Heating Capacity*

	Built-up Electric	Built-up Gas	Built-up Other	Packaged Electric	Packaged Gas	Packaged Other	Total
Colleges	2%	39%		9%	40%		80%
Food Stores	1%	3%	1%	25%	34%	1%	62%
Hospitals		18%	2%	26%	61%	0%	99%
Hotels, Motels	2%	16%	0%	40%	35%	5%	77%
Miscellaneous	0%	15%	3%	18%	32%	1%	63%
Offices	2%	9%	1%	24%	53%	3%	87%
Refrig Warehouses				28%	20%		45%
Restaurants		3%		33%	57%	1%	83%
Retail Stores	1%	6%	0%	28%	35%	4%	72%
Schools	1%	37%		59%	52%		95%
Warehouses		2%		34%	37%	2%	64%
Desert/Mountain	0%	2%	2%	17%	57%	7%	78%
Valley	0%	10%	0%	36%	38%	6%	83%
Coastal	3%	13%	1%	16%	29%	1%	58%
Hill	0%	6%	0%	35%	50%	0%	85%
Total	1%	8%	1%	27%	42%	3%	76%



Table 9 provides the installed heating capacity by heating equipment type by business type and climate.

Ninety-nine percent of hospital premises had heating capacity, followed by 95% for schools and 87% for offices. As one may expect, only 45% of refrigerated warehouses had heating capacity. While from 78% to 85% of commercial premises from the desert/mountain, valley, and hill climate zones had heating capacity, only 58% of commercial premises in the moderate coastal climate zone were heated.

Table 10 provides the percent of premises with heating capacity by equipment type by business type and climate zone. The total column is the percent of premises with any type of heating capacity. This column may be less than the sum of the equipment type percentages, because any one premise may have had more than one type of heating equipment.

### *Built-up Heating*

Built-up heating is a heating system used to heat various portions of a building through one or more heating units and a distribution system to circulate the heat. About 95% of built-up heating capacity used gas as the heating fuel, with less than 1% using electricity. Hot water boilers made up 65% of built-up heating capacity by equipment type, followed by steam boilers at 20% and gas furnaces at 13%.

Table 11 shows the built-up heating capacity by equipment type and fuel type.

### *Packaged Heating*

Packaged heating and cooling systems—combined heating and/or cooling equipment in one box or “package”—represented 59% of the installed heating capacity. Sixty-seven percent of packaged heating capacity used gas furnaces, while 16% used heat pumps. Gas was the fuel of choice, accounting for 75% of capacity, with electricity making up an additional 22%. Table 12 details packaged heating capacity by equipment type and fuel type.

**Table 11 - Built-up Heating Capacity (million Btu/h) by Equipment Type and Fuel Type**

	Electric	Gas	LPG	Other	Total
Electric Furnace	79				79
Gas Furnace		3,013	6		3,019
Hot Water Boiler	71	14,836	319	52	15,278
Steam Boiler		4,361		297	4,658
Other	38	114		293	444
Total	188	22,324	326	641	23,479

**Table 12 - Packaged Heating Capacity (million Btu/h) by Equipment Type and Fuel Type**

	Electric	Gas	LPG	Other	Total
Electric Heater	1,989				1,989
Gas Furnace		22,077	636	12	22,725
Heat Pump	5,383	182			5,564
Unit Heater	195	3,293	122	55	3,665
Total	7,567	25,551	759	67	33,944

**Table 13 - Cooling Capacity (thousand tons)**

	Built-up Electric	Built-up Gas	Built-up Other	Packaged Electric	Total Capacity
Colleges	48.7			54.1	102.8
Food Stores	22.3			54.4	76.7
Hospitals	89.5	0.8	1.2	88.7	180.1
Hotels, Motels	45.5			176.6	222.1
Miscellaneous	113.9	0.3		243.8	358.0
Offices	597.4	19.4	2.8	698.4	1,318.0
Refrig Warehouses	<0.1			8.6	8.6
Restaurants	1.3	0.6		251.7	253.6
Retail Stores	203.2	1.6		375.4	580.3
Schools	38.0	1.2		246.3	285.6
Warehouses	14.0	0.6		124.7	139.3
Desert/Mountain	109.8	1.1		511.2	622.0
Valley	321.9	1.2		644.8	967.9
Coastal	408.5	11.4	4.0	300.3	724.2
Hill	333.7	10.8		866.4	1,210.8
Total	1,173.9	24.5	4.0	2,322.8	3,525.0

**Table 14 - Percent of Premises with Cooling Capacity**

	Built-up Electric	Built-up Gas	Built-up Other	Packaged Electric	Total Capacity
Colleges	8%			74%	76%
Food Stores	3%			59%	61%
Hospitals	14%	0%	0%	86%	97%
Hotels, Motels	9%			47%	51%
Miscellaneous	3%	0%		46%	47%
Offices	7%	0%	0%	75%	79%
Refrig Warehouses	0%			43%	43%
Restaurants	0%	0%		79%	80%
Retail Stores	5%	0%		57%	62%
Schools	4%	1%		78%	78%
Warehouses	0%	0%		63%	63%
Desert/Mountain	1%	0%		88%	88%
Valley	6%	0%		75%	77%
Coastal	6%	0%	0%	29%	34%
Hill	4%	0%		75%	78%
Total	5%	0%	0%	64%	67%

**Table 15 - Installed Lighting Capacity (MW)**

	Incan- descent	Compact Fluores- cent	Fluores- cent Tube	Other	Total
Colleges	9.19		21.63	1.34	32.16
Food Stores	6.57	0.12	38.82	2.01	47.53
Hospitals	12.66	0.54	25.60	0.18	38.99
Hotels, Motels	163.12	2.04	484.00	28.05	677.21
Miscellaneous	55.48	0.75	64.30	64.88	185.41
Offices	88.60	4.80	244.88	24.58	362.87
Refrig Warehouses	1.13		2.46	13.57	17.16
Restaurants	29.36	0.66	17.36	1.41	48.79
Retail Stores	77.63	0.76	140.31	24.24	242.94
Schools	19.51	0.44	83.61	9.57	113.13
Warehouses	34.44	0.04	75.27	26.57	136.32
Desert/Mountain	52.47	0.83	97.43	29.02	179.75
Valley	180.67	3.23	634.41	64.03	882.34
Coastal	130.40	3.00	203.81	58.22	395.43
Hill	134.18	3.09	262.59	45.13	444.98
Total	497.71	10.15	1198.23	196.40	1,902.49

**Cooling**

PG&E's Commercial customers had approximately 3.53 million tons of installed cooling capacity. Over 99% of the installed capacity used electricity. Packaged electric cooling systems accounted for 2,322,800 tons or 66% of capacity, while built-up electric equipment accounted for an additional 33%.

Table 13 provides installed cooling capacity by equipment type and fuel type by business type and climate zone.

About 64% of premises had packaged electric cooling equipment, while 5% had built-up electric. Cooling equipment was found in 88% of premises in the desert/mountain climate zone characterized by extremely hot temperatures. Only 34% of premises in the coastal climate zone had cooling equipment.

Table 14 provides the percent of commercial premises with cooling capacity by business type and climate zone. The total column is the percent of premises with any cooling capacity. This column may be less than the sum of the equipment type percentages, because any one premise may have had more than one type of cooling equipment.

While built-up cooling only accounted for 34% of installed capacity, it represented all cooling capacity that did not use electricity as a fuel. Table 13 shows that 32% of the built-up cooling capacity in restaurants used gas as a fuel; this is misleading due to the small number of restaurants with built-up cooling. In all other business types, electricity accounted for a much larger percentage of built-up cooling capacity.

**Interior Lighting**

Commercial buildings in the PG&E service territory had approximately 1,900 megawatts of lighting capacity installed. Fluorescent tubes of varying length (2 to 8 feet) made up 63% of the installed lighting capacity, while incandescent lighting made up an additional 26%. Table 15 provides the installed lighting capacity by lighting equipment type by business type and climate zone.

## **Water Heating**

Seventy-six percent of water heating capacity by volume was made up of individual hot water tanks, while 21% used hot water only boilers. Approximately 3% of water heating capacity was made up of heat pump water heaters, instantaneous, purchased steam heat exchangers, and space heat boilers. Table 16 provides commercial water heating capacity in gallons by equipment type by business

type and climate zone.

Gas fueled 75% of water heating capacity, followed by electricity at 18% and LPG at 6%. Other fuels were utilized in less than 1% of water heating capacity.

Table 17 shows water heating capacity by equipment type and fuel type by business type and climate zone.

***Table 16 - Water Heating Capacity***

	Hot Water Only Boiler	Heat Pump Water Heater	Individual Hot Water Tank	Instantaneous	Purchased Steam Heat Exchanger	Space Heat Boiler	Total
Colleges	4,400		111,300	100			115,800
Food Stores	262,100	1,300	1,708,000		300	1,300	1,973,100
Hospitals	145,300		328,800	600	9,200	38,700	522,600
Hotels, Motels	327,200		621,400		41,100	76,400	1,066,100
Miscellaneous	918,200		1,032,500	6,900	1,000	7,900	1,966,500
Offices	256,700		1,680,700	13,000	7,100	66,400	2,024,000
Refrig Warehouses	1,800		31,000	1,400		500	34,700
Restaurants	106,300		1,507,900	1,200		1,500	1,616,800
Retail Stores	394,200		1,265,300	400			1,659,800
Schools	72,000		340,500			48,900	461,300
Warehouses	22,000		266,800			23,800	312,500
Desert/Mountain	411,000		1,035,600	3,100	2,800	48,400	1,500,900
Valley	585,300		1,448,400	1,000		2,800	2,037,500
Coastal	1,183,600		3,697,600	18,400	49,900	103,800	5,053,400
Hill	330,100	1,300	2,712,700	1,100	6,000	110,400	3,161,600
Total	2,510,000	1,300	8,894,300	23,600	58,800	265,400	11,753,400

***Table 17 - Water Heating Capacity by Equipment Type and Fuel Type***

	Electricity	Gas	LPG	Other	Total
Hot Water Only Boiler	129,800	1,905,700	474,500		2,510,000
Heat Pump Water Heater	1,300				1,300
Individual Hot Water Tank	2,001,100	6,649,400	215,400	28,400	8,894,300
Instantaneous	7,200	16,400			23,600
Purchased Steam Heat Exchanger	6,300	4,300		48,200	58,800
Space Heat Boiler	13,800	203,700		47,900	265,400
Total	2,159,500	8,779,500	689,900	124,500	11,753,400

## 4. Energy Usage

### Annual Energy Usage

The average PG&E commercial electric customer used 76,000 kWh annually, while the average gas customer used 440 MM Btu (1 MM Btu=1,000,000 Btu) per year.

On average, colleges were the largest users of electricity and gas at 668,000 kWh and 5,230 MM Btu per annum, whereas retail stores were the smallest at

39,000 kWh and 160 MM Btu annually. Offices accounted for 30% of commercial electric energy sales, approximately twice as much as retail stores, the next largest class. Offices were also the largest gas users at 21% of total sales, followed closely by restaurants at 18%. Table 18 provides the annual energy usage of PG&E commercial customers by business type and climate zone.

*Table 18- Annual Energy Usage*

	Annual kWh	Customers	Average	Annual MM Btu	Customers	Average
Colleges	592,020,000	900	668,000	4,974,000	950	5,230
Food Stores	2,579,050,000	13,200	196,000	1,552,000	6,990	220
Hospitals	1,288,670,000	2,300	550,000	7,249,000	2,860	2,540
Hotels, Motels	1,100,360,000	4,900	223,000	5,131,000	2,460	2,080
Miscellaneous	1,995,020,000	39,100	51,000	5,739,000	15,120	380
Offices	6,923,840,000	94,100	74,000	13,356,000	48,290	280
Refrig Warehouses	643,490,000	3,500	182,000	23,000	210	110
Restaurants	1,939,540,000	21,800	89,000	11,649,000	20,530	570
Retail Stores	3,717,350,000	94,700	39,000	5,707,000	35,420	160
Schools	907,300,000	5,000	181,000	5,133,000	3,110	1,650
Warehouses	1,237,950,000	22,700	55,000	4,265,000	10,060	420
Desert/Mountain	4,192,610,000	52,600	80,000	5,181,000	20,670	250
Valley	3,358,770,000	60,800	55,000	17,110,000	33,330	510
Coastal	6,552,600,000	89,000	74,000	18,788,000	31,380	600
Hill	8,820,610,000	100,000	88,000	23,699,000	60,620	390
Total	22,924,590,000	302,300	76,000	64,778,000	146,000	440

Table 19 provides quarterly electric and gas sales by business type and climate zone. The quarterly electric results do not sum to the annual electric totals since missing electric data was estimated to arrive at the annual total.

Electric usage peaked in the third quarter, in no small part due to the air conditioning loads of the summer. The seasonal usage of gas is also shown in this table,

with the first and fourth quarters showing higher gas usage than the second and third. This is due to increased demand for space heating in the cooler months. Offices in particular showed a large seasonal gas usage pattern, with gas usage doubling during the heating season. Schools also showed a large quarterly variation, undoubtedly exaggerated due to the fact that many schools are not in session during the summer.

*Table 19 - Quarterly Electric (MWh) and Gas (billion Btu) Usage*

	Electric Usage (MWh)				Gas Usage (billion Btu)			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Colleges	136,670	136,980	159,120	149,100	1,853	947	592	1,582
Food Stores	554,430	588,260	627,510	595,220	460	337	313	443
Hospitals	276,620	307,060	342,040	308,270	2,298	1,518	1,342	2,092
Hotels, Motels	217,880	220,740	250,720	240,190	1,492	1,160	1,070	1,408
Miscellaneous	309,330	309,230	348,000	456,810	1,921	1,005	972	1,841
Offices	1,512,500	1,590,960	1,738,470	1,656,790	4,913	2,306	1,721	4,416
Refrig Warehouses	74,030	95,260	129,530	90,330	8	3	4	7
Restaurants	384,750	434,500	484,200	424,590	3,104	2,720	2,719	3,106
Retail Stores	783,680	841,300	929,340	873,210	2,066	1,078	947	1,616
Schools	215,760	201,250	185,360	231,740	2,411	700	296	1,726
Warehouses	288,740	264,630	288,770	304,070	1,132	754	1,142	1,237
Desert/Mountain	705,670	818,550	980,890	889,830	1,703	905	921	1,652
Valley	663,750	694,720	795,200	722,030	6,339	2,935	2,235	5,601
Coastal	1,404,010	1,389,770	1,429,570	1,539,260	5,875	3,976	3,659	5,279
Hill	1,980,970	2,087,130	2,277,420	2,179,180	7,742	4,711	4,306	6,941
Total	4,754,400	4,990,170	5,483,080	5,330,300	21,658	12,528	11,120	19,472

## 5. End-Use Intensities and End-Use Sales

End-use intensities were calculated using SitePro modeling of the survey data (SitePro is a model developed by Regional Economic Research Inc. to simulate end use load shapes from survey data by using DOE-2 modeling for HVAC end uses and engineering models for other end uses).

For all end uses except cooling, heating, and ventilation, the total amount of energy used during the year for each end use was divided by the premise square footage for all premises with that end use to arrive at the end-use intensity. Heating, cooling, and ventilation were divided *only by the square footage served by those systems*. Therefore, if a premise was partially heated and used both gas and electricity as heating fuels, the electric end-use intensity for heating took the electric energy used in heating and divided it by the portion of the conditioned square footage served by the electric heating equipment, based on the percent of the total capacity that was electric.

The total column was calculated by taking the sum of all end uses for each site, summing those for each business type and climate, and dividing by the affected square footage. Table 20 shows the end-use intensities in kWh per square foot by business type and climate zone.

Food stores had the highest electric intensity at 45.2 kWh per square foot, with restaurants second at 37.3. Warehouses and schools were the least electric energy intensive business types at 3.9 and 5.9 kWh per square foot, respectively. As one may expect, restaurants had by far the largest cooking intensity at 14.5, while food stores and refrigerated warehouses had the largest refrigeration intensity at 27.6 and 23.3 kWh per square foot, respectively. Restaurants also had the largest cooling intensity, while food stores had the largest interior lighting intensity. Hospitals had the highest electric heating intensity, but only 2% of hospital square footage was heated by electricity.

*Table 20 - Annual Electric End-Use Intensities (kWh per Square Foot)*

	Cooling	Heating	Vent	Refrig- eration	Water Heating	Cooking	Interior Lighting	Other	Total
Colleges	6.31	3.62	1.71	0.27	0.74	0.31	7.36	2.26	17.44
Food Stores	5.38	2.59	2.52	27.58	0.44	3.16	9.45	1.50	45.17
Hospitals	4.99	44.73	10.49	0.89	1.07	1.30	7.14	2.71	20.23
Hotels, Motels	2.64	0.92	1.57	0.78	2.00	1.26	4.77	1.64	11.07
Miscellaneous	3.35	7.23	2.76	1.12	0.18	0.67	2.19	2.22	7.77
Offices	3.16	3.98	4.01	0.27	0.26	0.38	4.59	2.41	11.15
Refrig Warehouses	0.84	14.66	1.53	23.31	0.05	1.40	1.65	1.79	28.10
Restaurants	8.29	0.51	7.22	8.98	4.20	14.54	5.34	2.30	37.33
Retail Stores	3.85	3.54	5.09	1.32	0.23	0.66	6.73	2.45	14.17
Schools	1.70	2.38	3.95	0.27	0.37	0.26	2.34	0.63	5.91
Warehouses	2.09	6.09	1.47	0.29	0.14	0.12	1.63	0.94	3.86
Desert/Mountain	4.09	3.30	2.51	3.69	0.54	1.22	4.41	2.77	15.15
Valley	3.39	2.43	3.24	1.40	0.55	1.49	4.00	1.76	11.53
Coastal	2.87	4.36	3.06	2.23	0.23	0.87	3.84	1.54	9.73
Hill	3.45	3.87	5.41	1.83	0.33	1.38	4.67	2.01	12.74
Total	3.44	3.36	3.55	2.05	0.39	1.27	4.23	1.91	11.88

Restaurants had the largest gas intensity at 182 kBtu per square foot, with colleges following at 47.5. This was primarily due to restaurants' gas cooking intensity of 164.2 kBtu per square foot, which was over four times the cooking intensity of food stores, the next highest at 34.9. Restaurants also had the highest gas water heating intensity at 57.9, followed by

warehouses at 45.4. Refrigerated warehouses were the least gas intensive business type at only 3.9 kBtu per square foot.

Table 21 provides gas end-use intensities by business type and climate.

*Table 21 - Annual Gas End-Use Intensities (kBtu per Square Foot)*

	Cooling	Heating	Cooking	Process	Water Heating	Misc.	Total
Colleges	0.17	19.31	3.65		29.40	0.28	47.52
Food Stores		21.73	34.87		8.03		33.78
Hospitals		60.48	10.24	14.81	36.22	1.42	96.56
Hotels, Motels		20.36	15.91		32.70	2.22	38.43
Miscellaneous		33.08	15.57	3.87	23.49	3.01	39.55
Offices		22.42	7.43	0.58	10.26	1.92	26.54
Refrig Warehouses		18.98		0.00	1.43		3.93
Restaurants		16.36	164.17		57.94	7.75	181.97
Retail Stores		18.74	4.86	47.47	26.75	54.42	29.71
Schools		26.16	3.95		6.99	0.51	30.44
Warehouses		26.67	12.66	5.23	45.39	0.47	29.56
Desert/Mountain	0.17	23.34	20.83	0.00	14.72	2.79	35.33
Valley		33.57	24.03	3.87	12.70	0.38	39.27
Coastal		24.61	19.95	1.17	26.00	9.21	44.80
Hill		21.44	25.18	40.08	23.63	3.37	36.56
Total		25.26	22.62	10.19	20.83	3.42	39.36

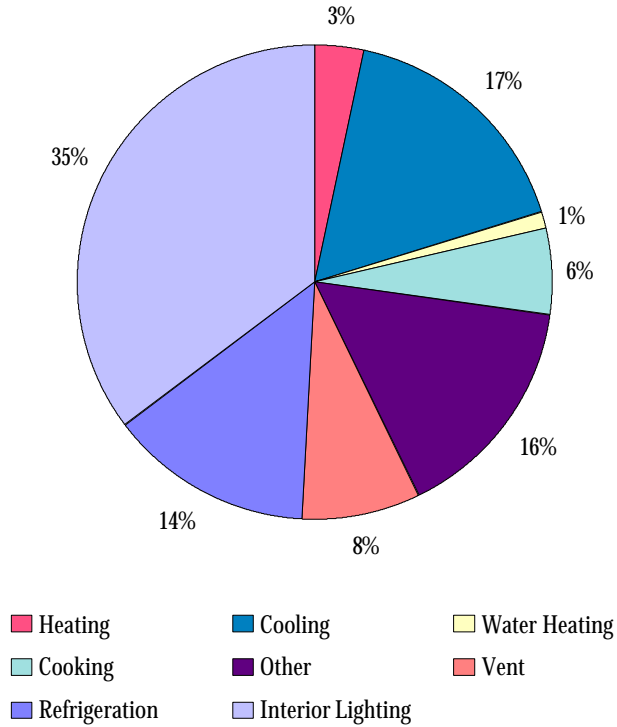
Interior lighting accounted for approximately 35% of commercial electric sales, followed by cooling, other, and refrigeration at 17%, 16%, and 14% respectively. The combination of heating, cooling, and vent made up about 28% of electric sales. Figure 8 provides the percent of annual electric sales by end use.

Heating accounted for 43% of commercial gas sales. Water heating made up an additional 35% and

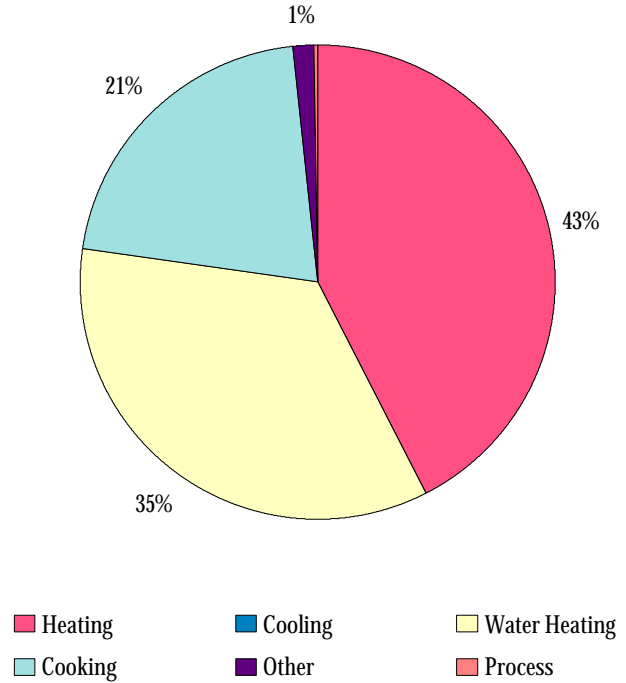
cooking another 21%. Cooling, process, and other combined for approximately 1% of gas sales. Figure 9 provides an estimate of the percent of annual commercial gas sales by end use.

Figures 10 through 39 provide annual end-use sales percentages by business type and climate zone.

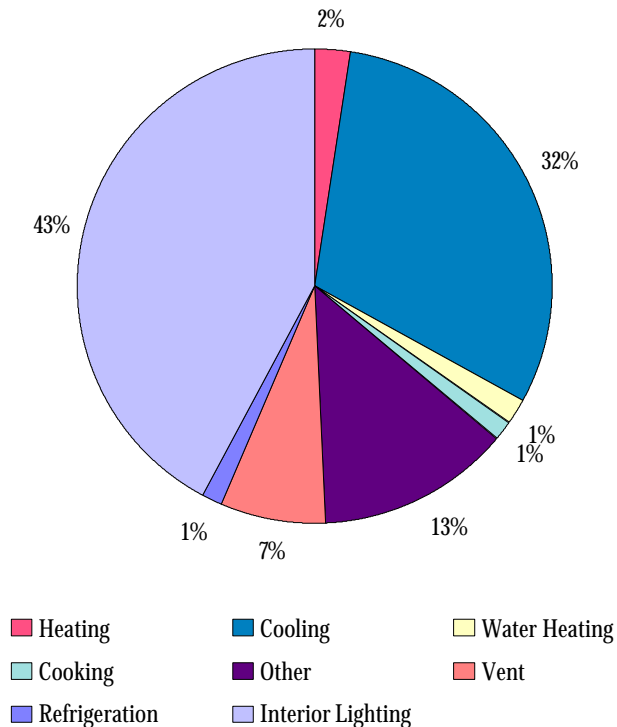
*Figure 8 - Percent of Annual Electric Sales by End Use*



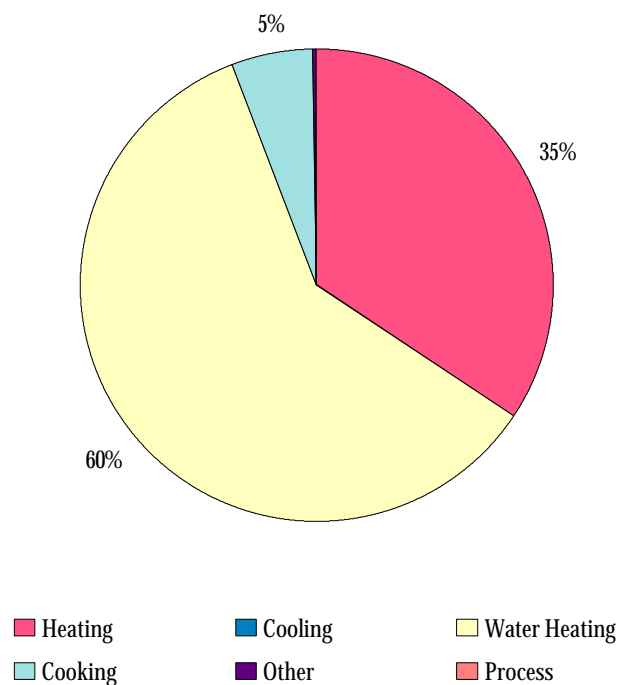
*Figure 9 - Percent of Annual Gas Sales by End Use*



*Figure 10 - Percent of Annual Colleges Electric Sales by End Use*

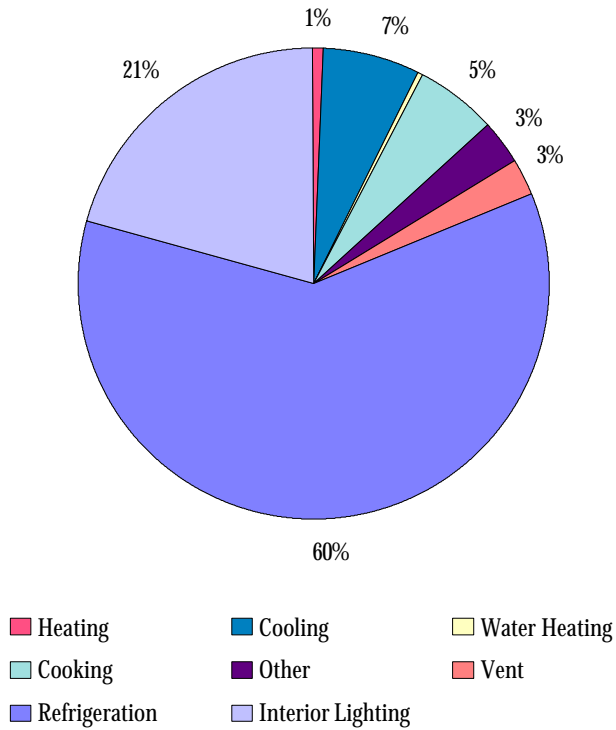


*Figure 11 - Percent of Annual Colleges Gas Sales by End Use*

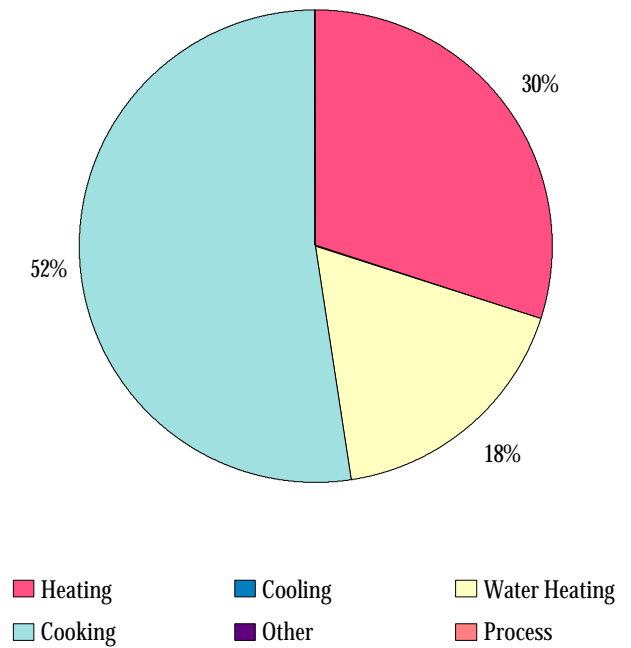




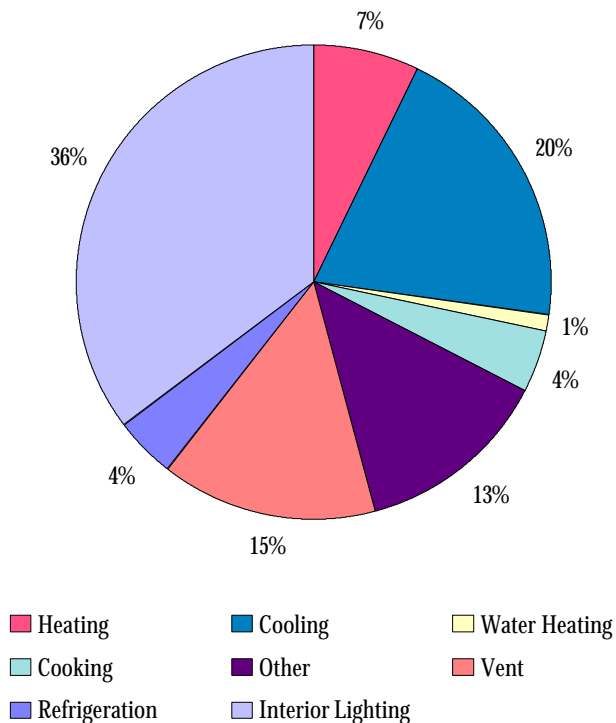
**Figure 12 - Percent of Annual Food Stores Electric Sales by End Use**



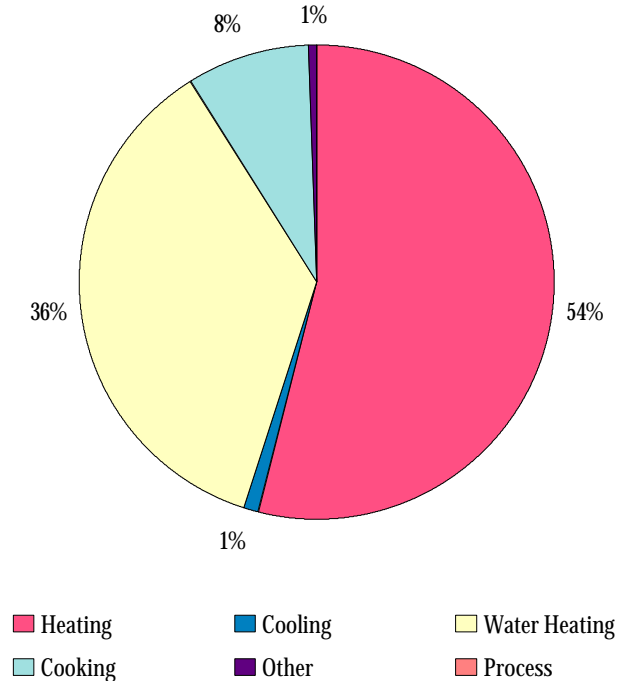
**Figure 13 - Percent of Annual Food Stores Gas Sales by End Use**



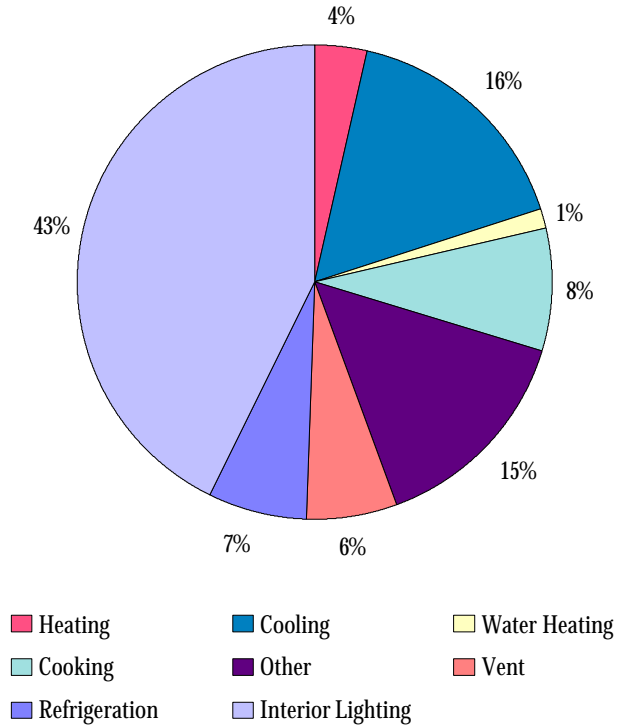
**Figure 14 - Percent of Annual Hospitals Electric Sales by End Use**



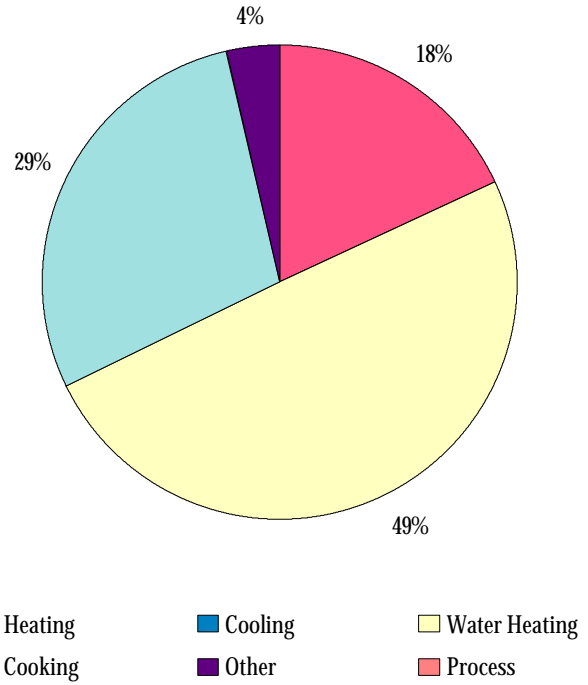
**Figure 15 - Percent of Annual Hospitals Gas Sales by End Use**



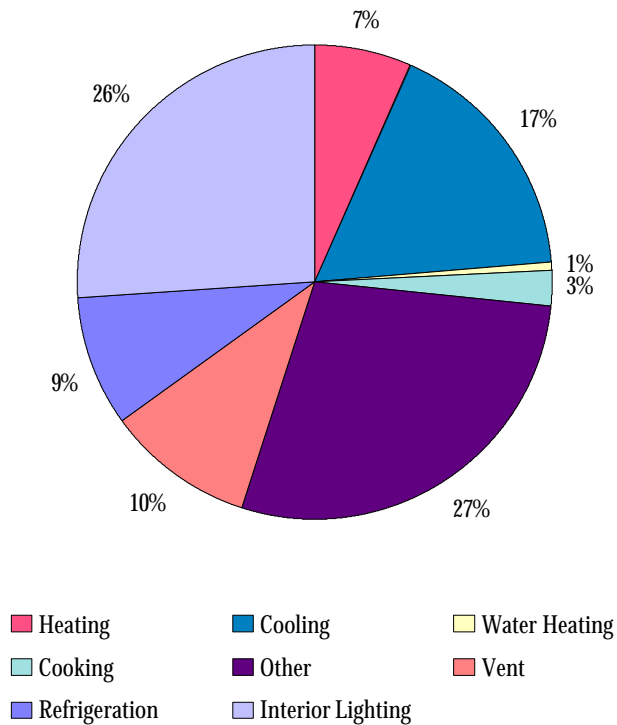
**Figure 16 - Percent of Annual Hotels and Motels Electric Sales by End Use**



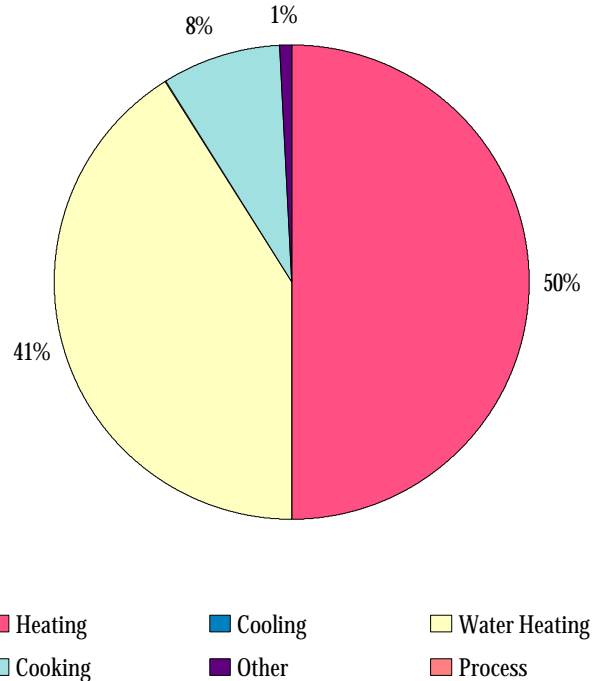
**Figure 17 - Percent of Annual Hotels and Motels Gas Sales by End Use**



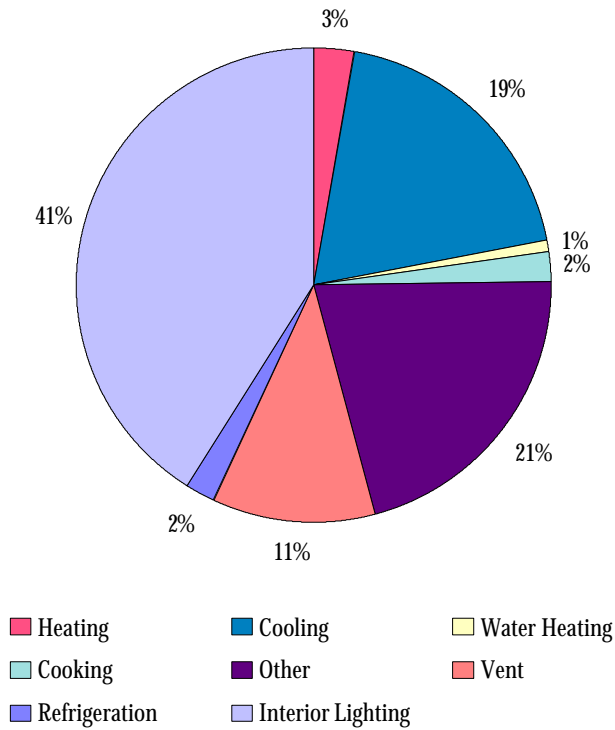
**Figure 18 - Percent of Annual Miscellaneous Electric Sales by End Use**



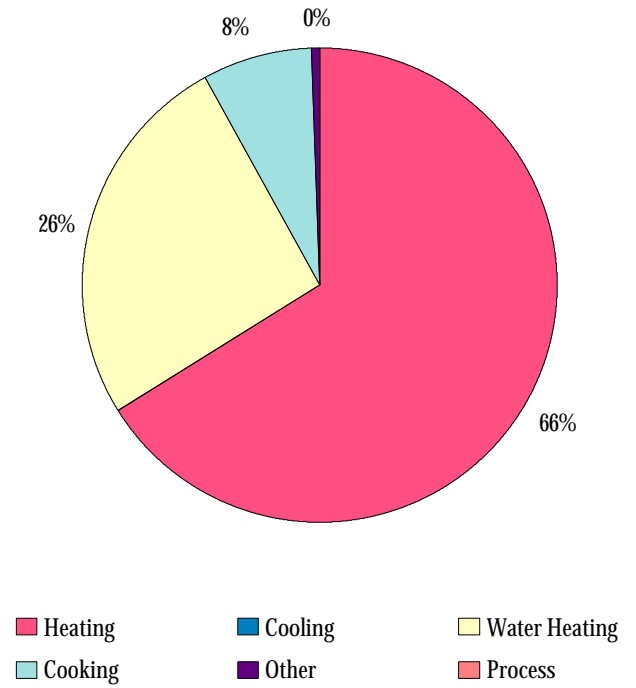
**Figure 19 - Percent of Annual Miscellaneous Gas Sales by End Use**



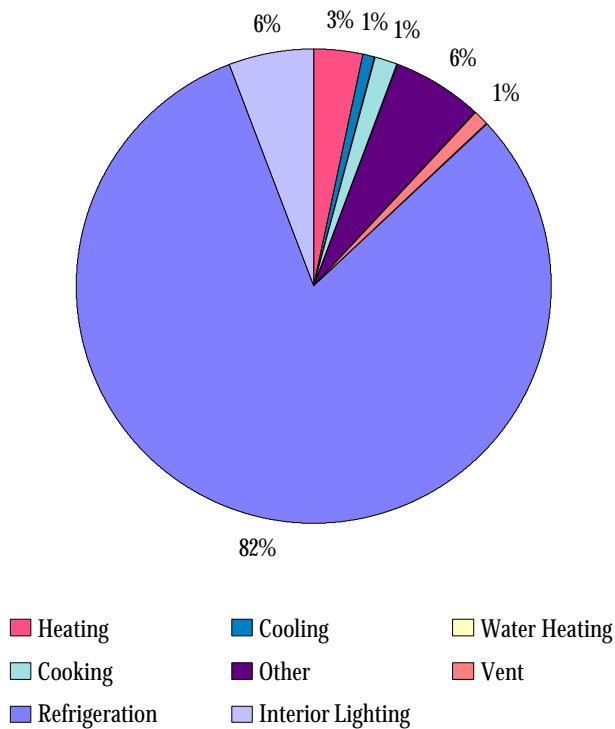
**Figure 20 - Percent of Annual Offices  
Electric Sales by End Use**



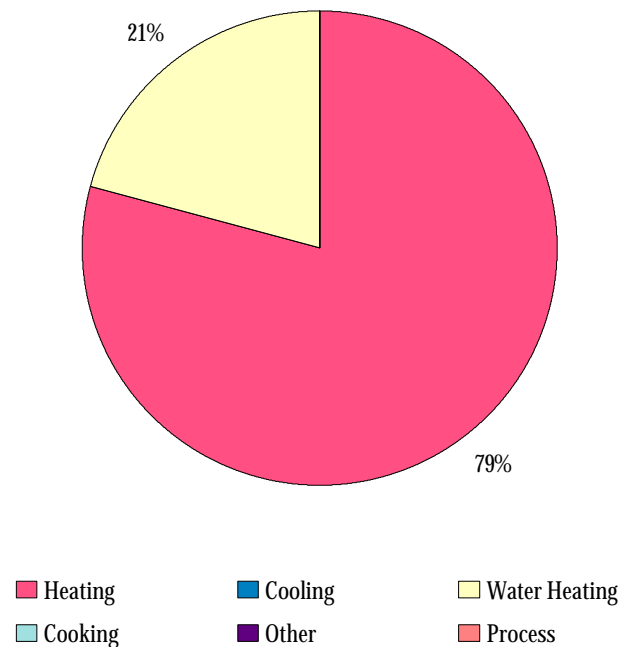
**Figure 21 - Percent of Annual Offices  
Gas Sales by End Use**



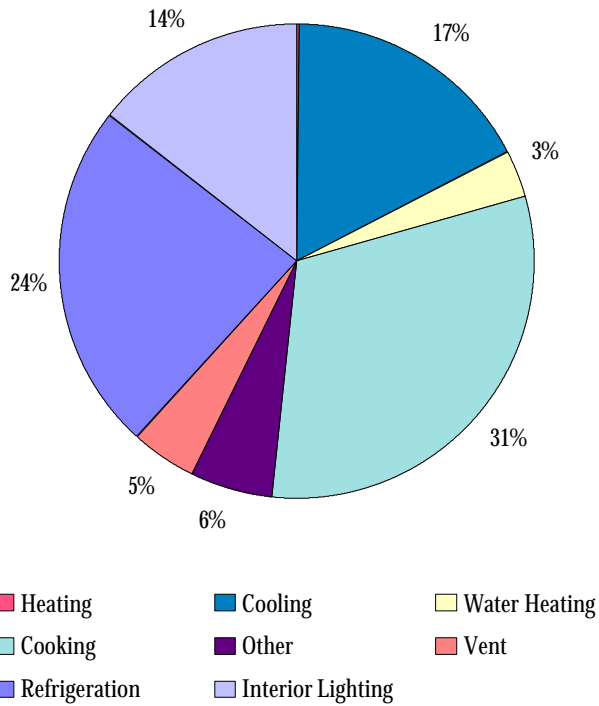
**Figure 22 - Percent of Annual Refrigerated  
Warehouses Electric Sales by End Use**



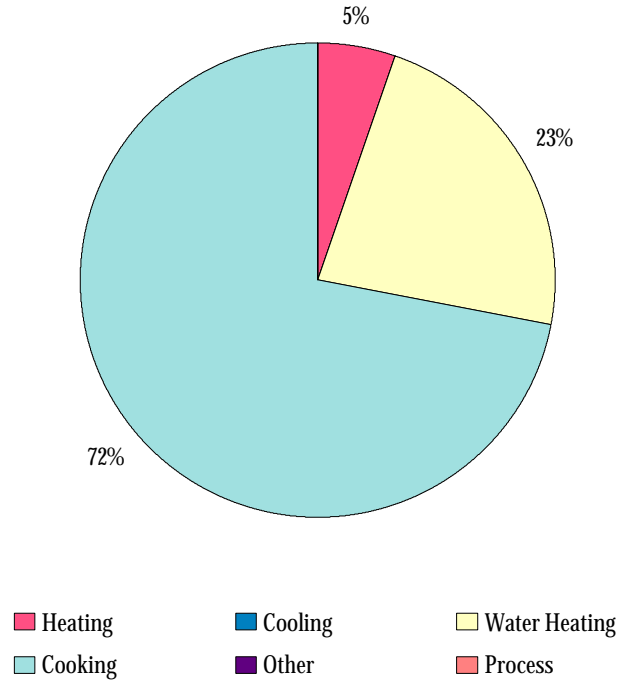
**Figure 23 - Percent of Annual Refrigerated  
Warehouses Gas Sales by End Use**



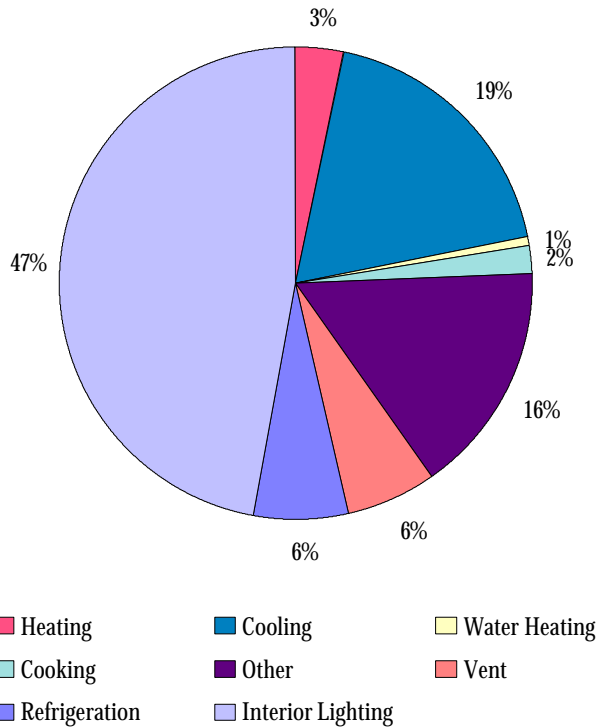
**Figure 24 - Percent of Annual Restaurants Electric Sales by End Use**



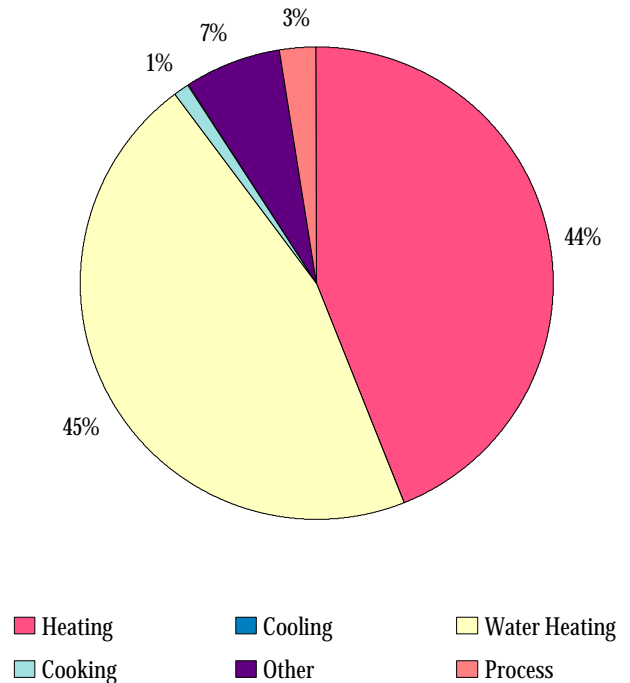
**Figure 25 - Percent of Annual Restaurants Gas Sales by End Use**



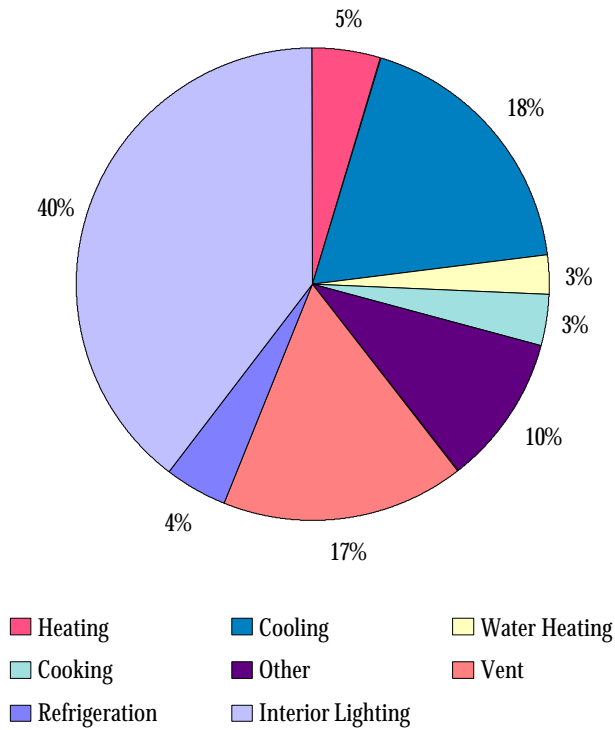
**Figure 26 - Percent of Annual Retail Stores Electric Sales by End Use**



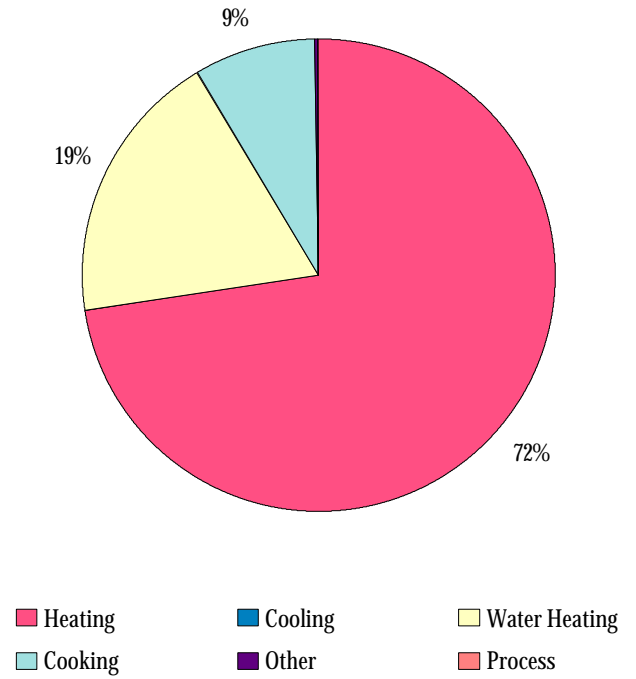
**Figure 27 - Percent of Annual Retail Stores Gas Sales by End Use**



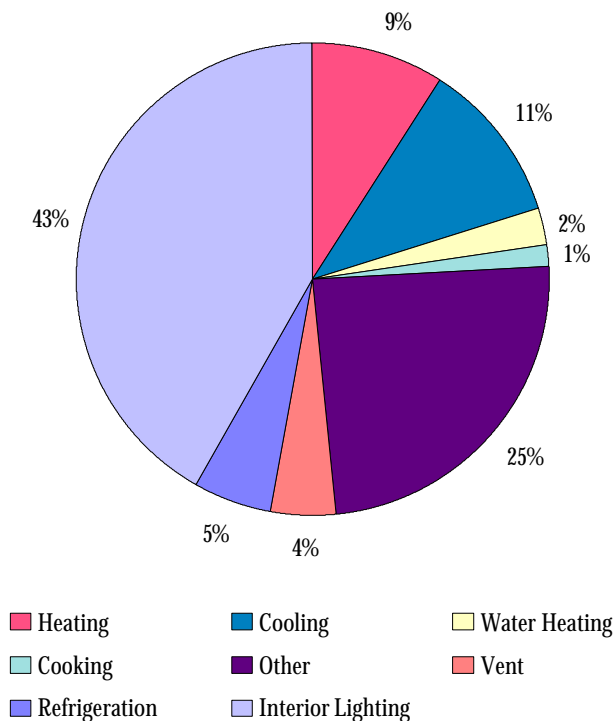
**Figure 28 - Percent of Annual Schools Electric Sales by End Use**



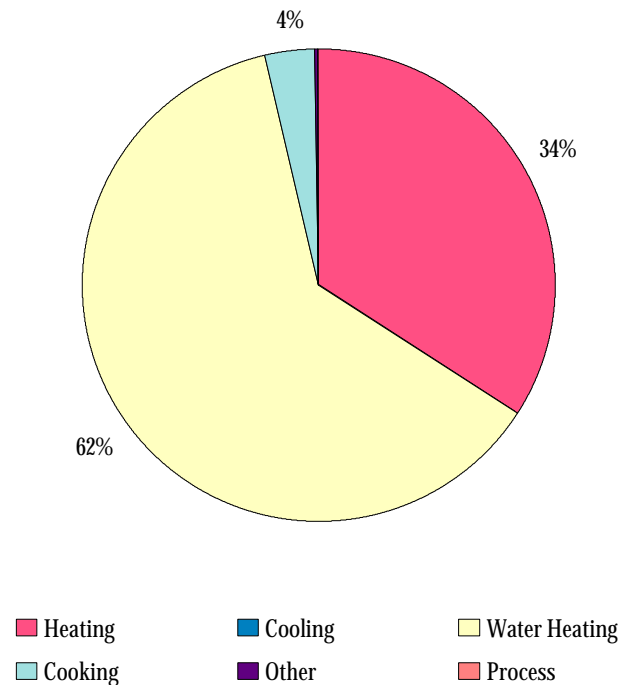
**Figure 29 - Percent of Annual Schools Gas Sales by End Use**



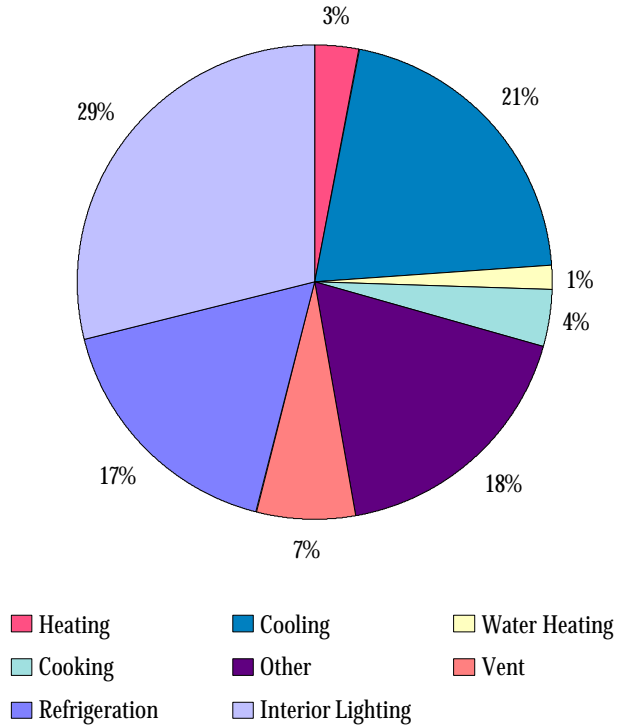
**Figure 30 - Percent of Annual Warehouses Electric Sales by End Use**



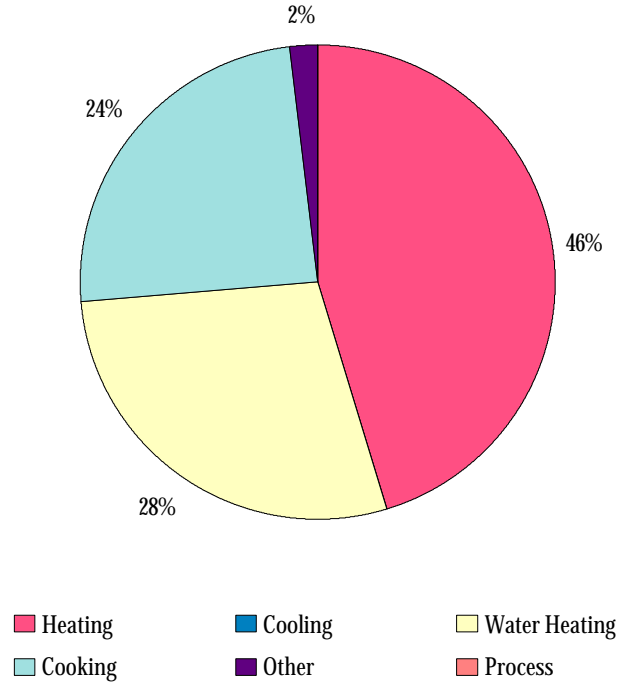
**Figure 31 - Percent of Annual Warehouses Gas Sales by End Use**



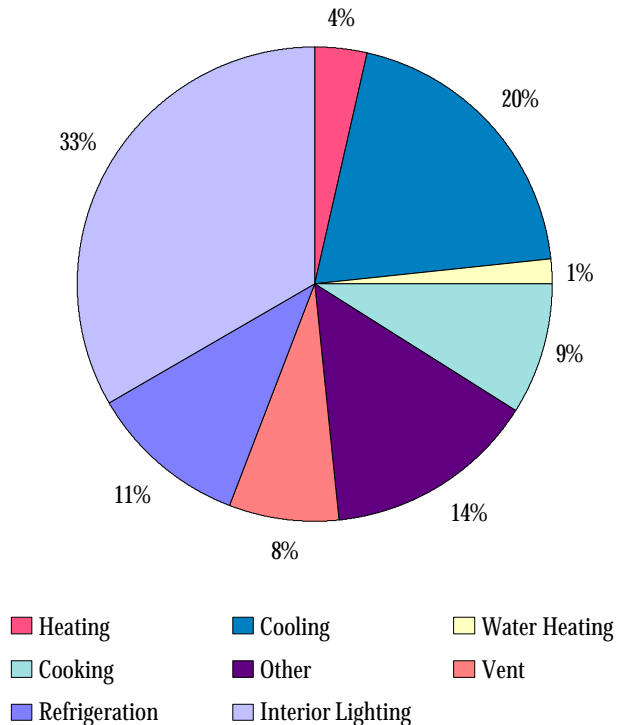
**Figure 32 - Percent of Annual Desert/Mountain Climate Zone Electric Sales by End Use**



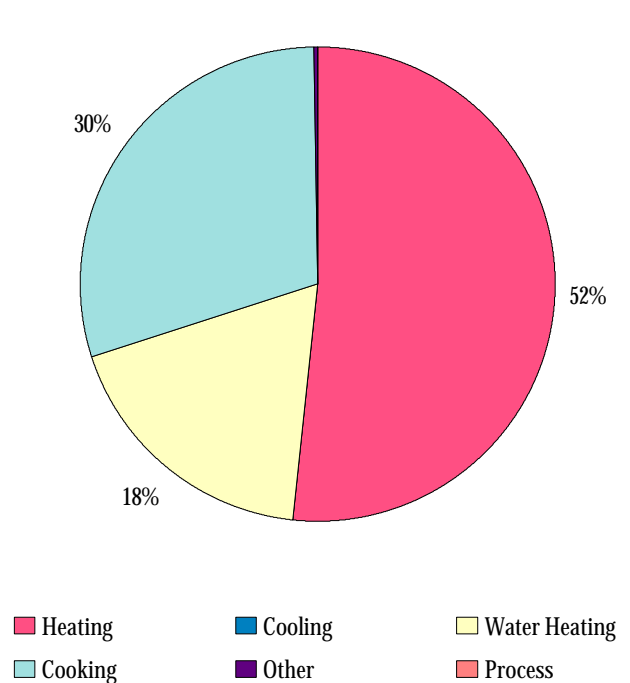
**Figure 33 - Percent of Annual Desert/Mountain Climate Zone Gas Sales by End Use**



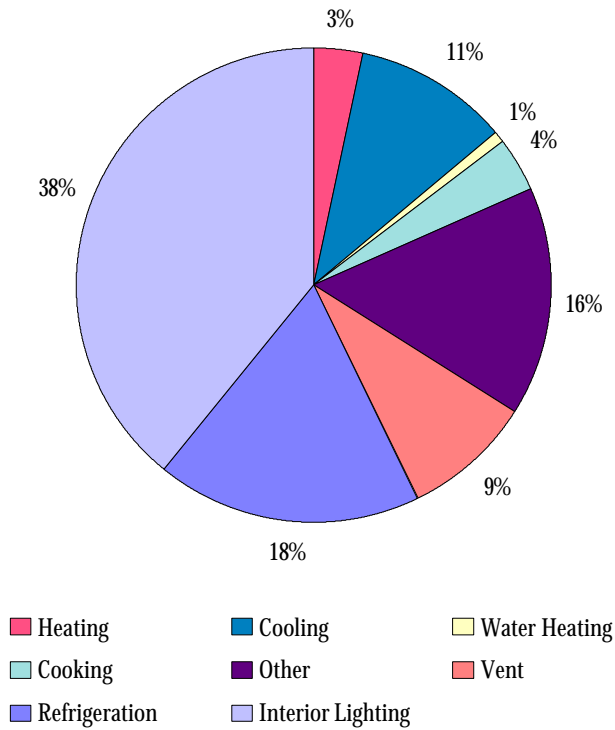
**Figure 34 - Percent of Annual Valley Climate Zone Electric Sales by End Use**



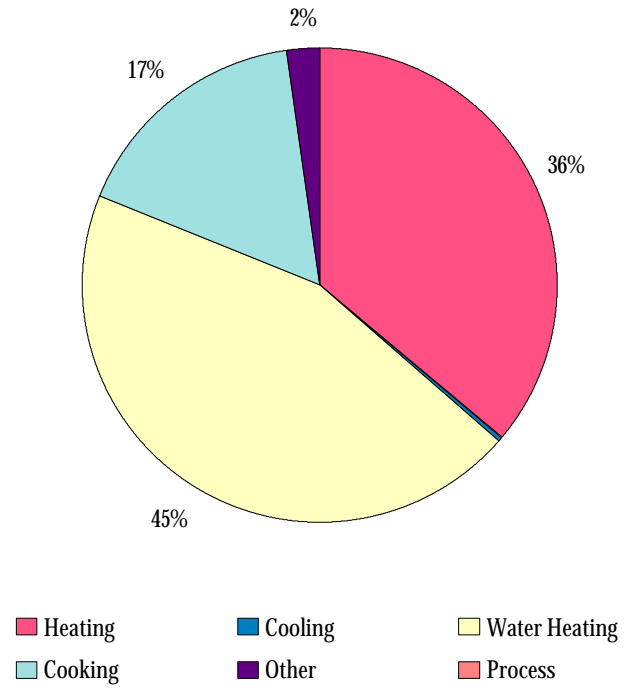
**Figure 35 - Percent of Annual Valley Climate Zone Gas Sales by End Use**



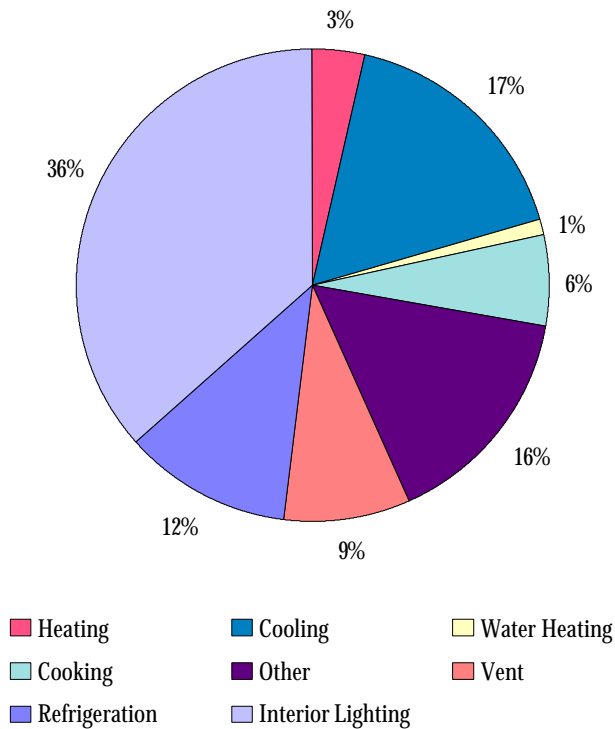
**Figure 36 - Percent of Annual Coastal Climate Zone Electric Sales by End Use**



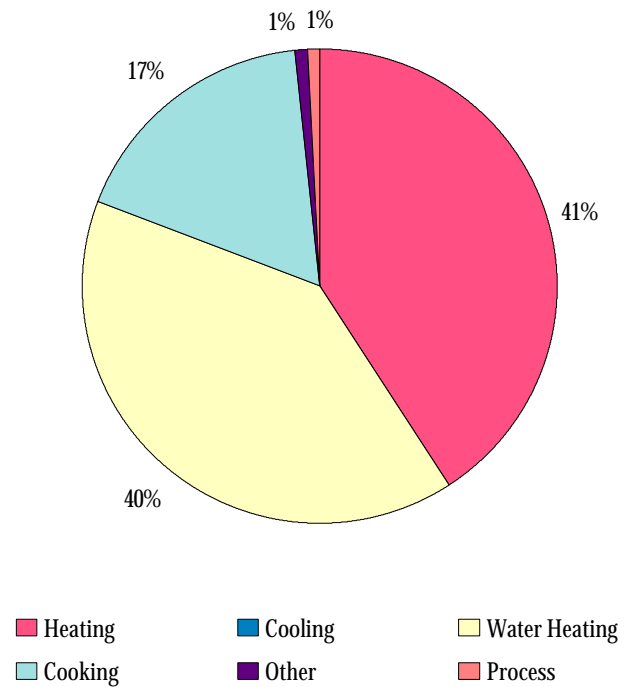
**Figure 37 - Percent of Annual Coastal Climate Zone Gas Sales by End Use**



**Figure 38 - Percent of Annual Hill Climate Zone Electric Sales by End Use**



**Figure 39 - Percent of Annual Hill Climate Zone Gas Sales by End Use**



## 6. Appendix

### **Premise Definition**

A premise was defined as a specific customer at a specific location. For example, Joe's Deli occupies the first floor of a five story building, and Bill's Legal Firm occupies the other four floors, plus a two story building on the same side of the same block with a different address. These were considered as two premises, one for each business. However, if the legal firm purchased Joe's Deli and made it into a cafeteria for the firm, it would have been considered one premise.

### **Business Type Definition**

Business types were assigned by mapping the corrected site activity Standard Industrial Classification (SIC) code into 11 business types. Table 22 shows how SIC Codes are mapped into business types.

### **General Table Format**

With a few exceptions, the tables in this report were designed to provide detail at the business type and climate zone level. The first eleven rows after the column titles give results by business type. Following a blank row, the next four rows give results by climate zone. The last row provides totals. The total row is the sum for both the business type and climate zone sections. The business type and climate zone sections are two intermediate views of the same total. Therefore, summing an entire column will double the actual total.

### **Data Cleaning**

This report used a sample of 1912 surveys for analysis. Sixty-five surveys were removed from the sample size of 1977 surveys on which weights were based. Most were mislabeled as commercial accounts when the sample was drawn.

*Table 22 - SIC Code to Business Type Mapping*

SIC Code Mapping	
Colleges	822, 824-829 except 8241
Food Stores	540-549
Hospitals	805-807
Hotels, Motels	700-709
Miscellaneous	000-099, 680-699, 710-719, 740-759, 770-800, 840-859, 870-889, 970-999
Offices	600-679, 730-739, 801-804, 808-819, 823, 8241, 830-839, 860-869, 890-969
Refrig Warehouses	4222, 5142-5144, 5146-5148
Restaurants	580-589
Retail Stores	520-539, 550-579, 590-599, 720-729, 760-769
Schools	820-821
Warehouses	4220-4221, 4223-4229, 5000-5141, 5145, 5149-5199



### **Weighting Techniques**

Two weights were used in this report. A mean per unit weight was used to calculate the number of premises and other information solely related to the number of premises in the population. A ratio weight based on energy usage was used to calculate all other tables and figures. Both weights used 1993 as the base year.

Tables that calculate an average per premise were developed by first using the energy weight to calculate the sum of the variable of interest. Second, the mean per unit weight was used to calculate the number of premises. The average was then calculated by dividing the sum of the variable of interest by the number of premises.

### **Climate Zone Definition**

PG&E's service territory was mapped into four climate zones for purposes of this analysis. The desert/mountain climate zone is characterized by extremely hot temperatures. The valley climate zone has hot temperatures, while the hill climate zone is characterized by moderate temperatures. The coastal climate zone has cooler temperatures.

Figure 40 shows how PG&E's service territory is divided into the climate zones.

*Figure 40 - Climate Zone Map*

