CALIFORNIA COMMERCIAL END-USE SURVEY

Chapter 8

CONSULTANT REPORT

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Prepared By:
Itron, Inc.

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This report is dedicated to the memory of Alan Fields, who served as the project manager until his death on February 3, 2004. Alan was a valued colleague and dear friend. He will be missed by his associates at Itron, the California Energy Commission, and the energy industry.

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CHAPTER 8: STATEWIDE RESULTS BY SEGMENT

8.1 Introduction

This chapter summarizes the statewide results of the CEUS analysis. In this context, the term "statewide" refers to the service areas of the four electric utilities represented in the CEUS database: PG&E, SCE, SDG&E, and SMUD. Other areas of the state are omitted from the analysis because they were not covered by the survey. Section 8.2 provides an overview of the composition of statewide energy usage by building type and end use. Section 8.3 presents statewide electric and gas fuel shares, energy-use indices (EUIs), and energy intensities at the end-use level by building type. Section 8.4 provides statewide 16-day hourly end-use electric shapes by building type. For all results presented in this chapter, the end uses and building types are as described in Chapter 7 of this report.

Additional results for the California Energy Commission Forecasting Climate Zones encompassed by the four electric utility service areas (1 through 10 and 13) were also generated. The database containing these results is described in Appendix I.

8.2 Overview of Statewide Energy Usage

Table 8-1, Figure 8-1 and Figure 8-2 depict the estimates of statewide floor stock, energy intensities, and energy usage by building type. Energy intensities and annual usage were generated using normalized weather data and 2002 as the base year, and represent total customer consumption rather than just purchases from utilities or other vendors. As noted in Chapter 7, both electric and gas estimates are strictly limited to the covered electric service areas. It is particularly important to note that total gas consumption excludes much of Southern California Gas Company's service area.

Total commercial floor stock in the covered electric service areas is estimated to be just over 4.9 billion square feet. The building types accounting for the largest percentage of total commercial floor stock are Miscellaneous (with approximately 22% of the total), Retail (14%), and Large Offices (13%).

Total commercial electric consumption is 67,707 GWh annually, and natural gas usage (again, in the covered electric service areas) is roughly 1279 million therms (Mtherms) per year. The largest shares of total electricity consumption are in Large Offices (17%), Miscellaneous (16%), and Retail (15%). For natural gas usage, three building types account for over 58% of the usage: Restaurants (24%), Miscellaneous (20%) and Health (14%).

Figure 8-3 and Figure 8-4 depict estimates of statewide electric and gas usage percentages by end use. The primary electric end uses are interior lighting (29%), cooling (15%), refrigeration (13%), and ventilation (12%). The primary natural gas end uses are space heating (36%) and water heating (32%).

Electric and gas usage and energy intensities by end use and building type are presented in Table 8-2 through Table 8-5. As indicated in Table 8-3, for the statewide commercial sector the highest electric end-use energy intensities are interior lighting (3.92 kWh per square foot), followed by cooling (2.04), refrigeration (1.83), and ventilation (1.63). According to Table 8-5, the highest natural *gas* end-use energy intensities are space heating (9.5 kBtu per square foot), water heating (8.3) and cooking (5.9).

EUIs by building type and end use are presented in Section 8-3.

Table 8-1: Overview of Energy Usage in the Statewide Service Area

		Annual Energy Intensities			Total Annual Usage	
Building Type	Floor Stock (kft^2)	Electricity (kWh/ft^2)	Natural Gas ($therms/ft^2$)	Natural Gas ($kBtu/ft^2$)	Electricity (GWh)	Natural Gas (Mtherms)
All Commercial	4,920,114	13.63	0.26	25.99	67077	1278.60
Small Office (<30k ft2)	361,584	13.10	0.11	10.54	4738	38.10
Large Office (>=30k ft2)	660,429	17.70	0.22	21.93	11691	144.80
Restaurant	148,892	40.20	2.10	209.98	5986	312.60
Retail	702,053	14.06	0.05	4.62	9871	32.50
Food Store	144,209	40.99	0.28	27.60	5911	39.80
Refrigerated Warehouse	95,540	20.02	0.06	5.60	1913	5.30
Unrefrigerated Warehouse	554,166	4.45	0.03	3.07	2467	17.00
School	445,106	7.46	0.16	15.97	3322	71.10
College	205,942	12.26	0.34	34.24	2524	70.50
Health	232,606	19.61	0.76	75.53	4561	175.70
Lodging	270,044	12.13	0.42	42.40	3275	114.50
Miscellaneous	1,099,544	9.84	0.23	23.34	10817	256.60
All Offices	1,022,012	16.08	0.18	17.90	16430	182.90
All Warehouses	649,706	6.74	0.03	3.44	4380	22.40

Figure 8-1: Electricity Use by Building Type

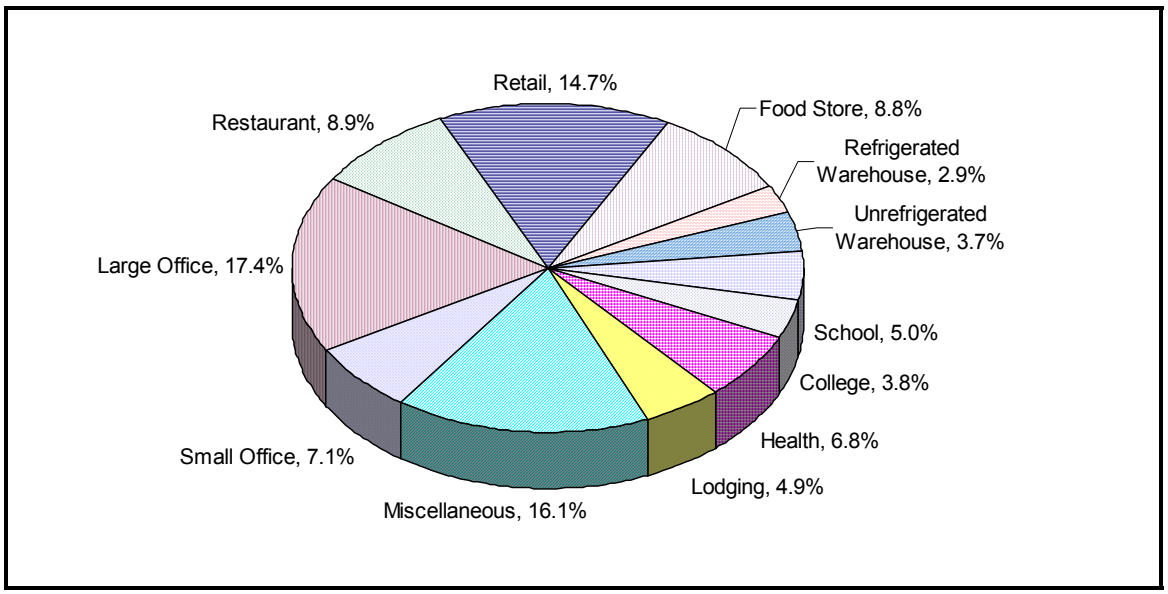

Figure 8-2: Natural Gas Usage by Building Type

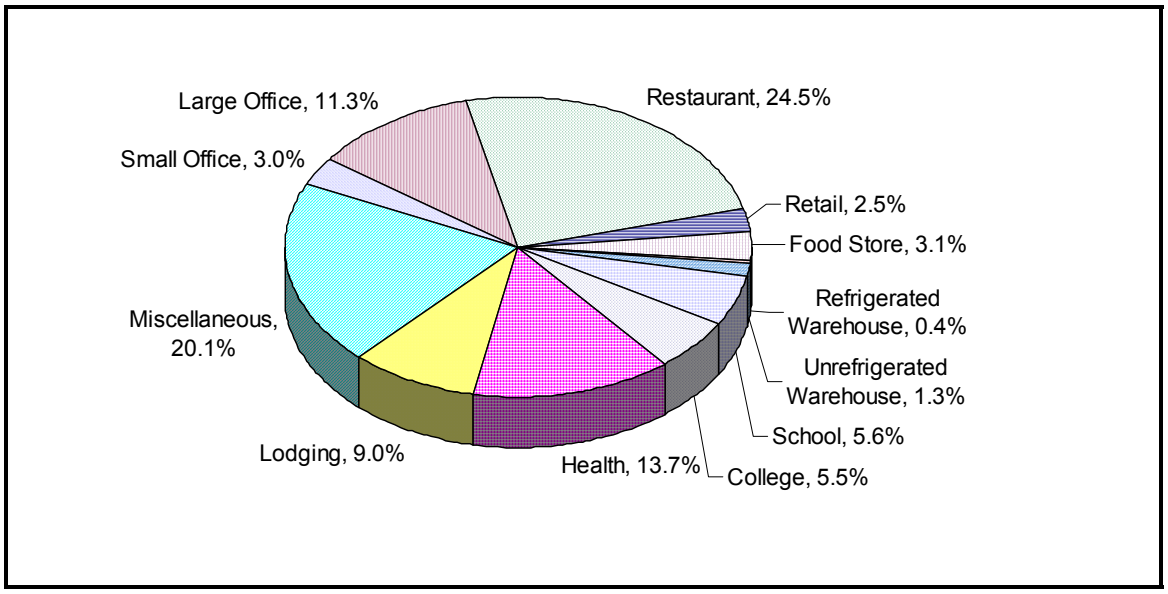

Figure 8-3: Electric Usage by End Use

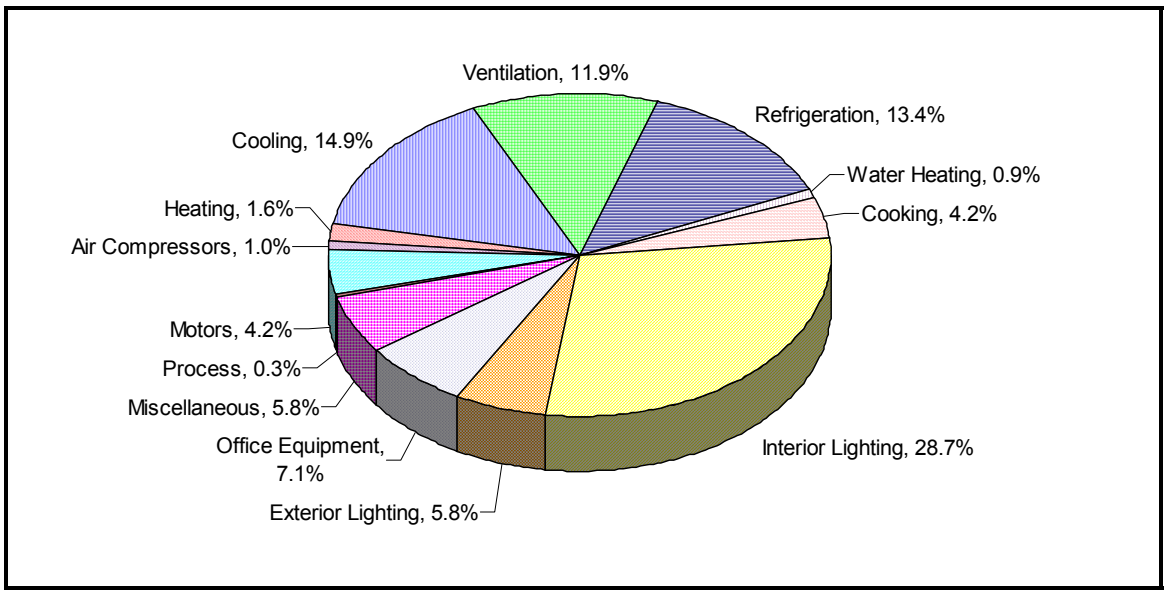

Figure 8-4: Natural Gas Usage by End Use

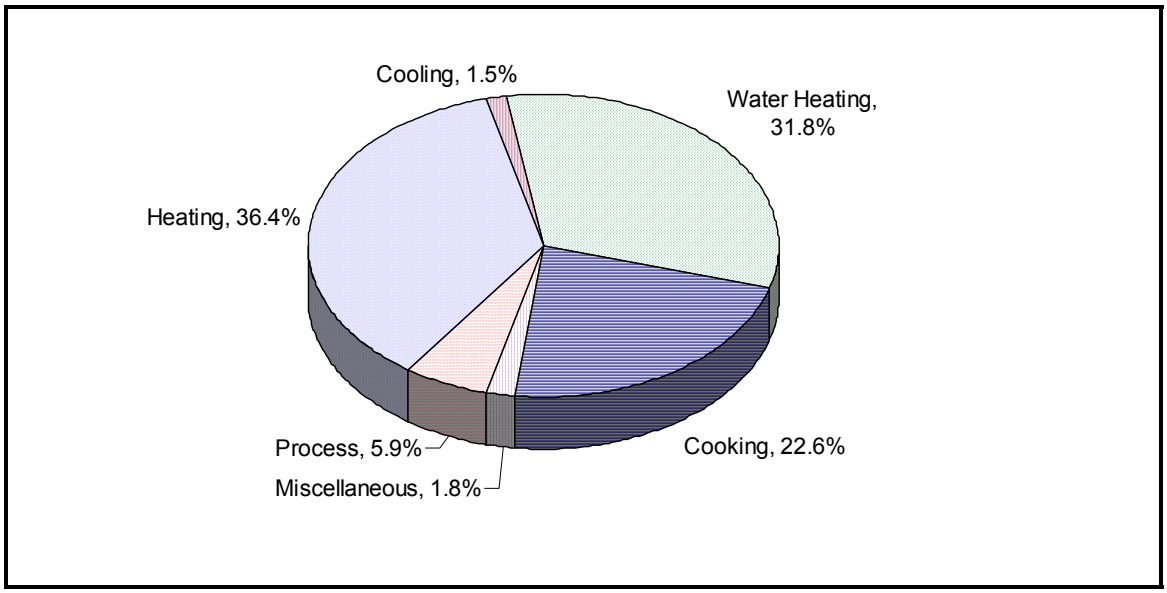

Table 8-2: Electric Usage (GWh) by Building Type and End Use

Building Type	Heat	Cool	Vent.	Refrig.	WH	Cook	Int. Ltg.	Ext. Ltg.	Office Equip.	Misc.	Air Comp.	Motors	Proc.	Total
All Commercial	1,087	10,017	8,000	9,014	611	2,805	19,265	3,916	4782	3924	204	2811	642	67,077
Small Office	72	943	467	208	90	38	1,386	343	793	283	1	79	36	4,739
Large Office	322	2358	2,019	268	80	77	2,945	324	2365	383	18	474	60	11,691
Restaurant	7	858	482	1,469	56	1,546	961	300	94	168	1	41	3	5,986
Retail	55	1553	1,267	726	96	157	4,246	644	343	483	37	201	64	9,871
Food Store	12	415	372	3,233	20	266	1,233	137	54	138	1	26	6	5,911
Refrigerated Warehouse	2	31	23	1284	3	3	262	33	17	55	4	174	22	1,913
Unrefrigerated Warehouse	20	183	156	154	26	12	1,223	145	131	215	9	162	32	2,467
School	56	520	429	225	43	78	1,281	330	206	110	1	37	7	3,322
College	159	393	423	95	25	55	790	188	148	100	2	119	28	2,524
Health	166	901	940	166	18	101	1,119	132	200	586	1	181	50	4,561
Lodging	114	650	483	244	9	185	945	165	46	301	0	128	6	3,275
Miscellaneous	104	1,212	941	942	145	287	2,874	1,175	386	1103	129	1190	330	10,817
All Offices	393	3,301	2,485	476	171	115	4,331	666	3157	666	19	553	95	16,430
All Warehouses	22	214	179	1,438	28	15	1,485	178	148	270	13	336	54	4,380

Table 8-3: Electric Energy Intensities (kWh/ft^2-yr) by Building Type and End Use

Building Type	Total	Heat	Cool	Vent.	Refrig.	WH	Cook	Int. Ltg.	Ext. Ltg.	Office Equip.	Misc.	Air Comp.	Motors	Proc.
All Commercial	13.63	0.22	2.04	1.63	1.83	0.12	0.57	3.92	0.80	0.97	0.80	0.04	0.57	0.13
Small Office	13.10	0.20	2.61	1.29	0.58	0.25	0.10	3.83	0.95	2.19	0.78	0.00	0.22	0.10
Large Office	17.70	0.49	3.57	3.06	0.41	0.12	0.12	4.46	0.49	3.58	0.58	0.03	0.72	0.09
Restaurant	40.20	0.05	5.76	3.24	9.87	0.38	10.38	6.45	2.02	0.63	1.13	0.01	0.27	0.02
Retail	14.06	0.08	2.21	1.81	1.03	0.14	0.22	6.05	0.92	0.49	0.69	0.05	0.29	0.09
Food Store	40.99	0.08	2.88	2.58	22.42	0.14	1.85	8.55	0.95	0.37	0.95	0.01	0.18	0.04
Refrigerated Warehouse	20.02	0.02	0.33	0.24	13.44	0.03	0.04	2.74	0.35	0.17	0.57	0.04	1.82	0.23
Unrefrigerated Warehouse	4.45	0.04	0.33	0.28	0.28	0.05	0.02	2.21	0.26	0.24	0.39	0.02	0.29	0.06
School	7.46	0.13	1.17	0.96	0.50	0.10	0.18	2.88	0.74	0.46	0.25	0.00	0.08	0.01
College	12.26	0.77	1.91	2.05	0.46	0.12	0.27	3.84	0.91	0.72	0.49	0.01	0.58	0.14
Health	19.61	0.71	3.87	4.04	0.71	0.08	0.43	4.81	0.57	0.86	2.52	0.01	0.78	0.22
Lodging	12.13	0.42	2.41	1.79	0.90	0.03	0.68	3.50	0.61	0.17	1.11	0.00	0.48	0.02
Miscellaneous	9.84	0.09	1.10	0.86	0.86	0.13	0.26	2.61	1.07	0.35	1.00	0.12	1.08	0.30
All Offices	16.08	0.38	3.23	2.43	0.47	0.17	0.11	4.24	0.65	3.09	0.65	0.02	0.54	0.09
All Warehouses	6.74	0.03	0.33	0.28	2.21	0.04	0.02	2.29	0.27	0.23	0.42	0.02	0.52	0.08

Table 8-4: Natural Gas Usage (Mtherms) by Building Type and End Use

Building Type	Heat	Cool	WH	Cook	Misc.	Proc.	Total
All Commercial	465.50	19.10	406.70	289.10	23.00	75.20	1278.60
Small Office	31.20	0.00	6.00	0.50	0.10	0.40	38.10
Large Office	113.70	3.60	17.20	1.50	0.70	8.10	144.80
Restaurant	11.50	0.00	72.40	228.20	0.00	0.50	312.60
Retail	21.20	0.00	5.50	3.60	1.90	0.30	32.50
Food Store	13.70	0.00	11.00	14.90	0.00	0.10	39.80
Refrigerated Warehouse	0.80	0.00	0.80	1.20	0.00	2.70	5.30
Unrefrigerated Warehouse	14.80	0.00	1.80	0.10	0.20	0.10	17.00
School	44.60	0.60	20.90	4.70	0.10	0.30	71.10
College	40.80	7.10	17.30	3.40	1.80	0.00	70.50
Health	76.10	3.60	73.00	7.80	3.40	11.80	175.70
Lodging	19.70	0.20	78.20	11.90	3.90	0.70	114.50
Miscellaneous	77.40	4.00	102.70	11.20	10.90	50.30	256.60
All Offices	144.90	3.60	23.20	2.00	0.80	8.40	182.90
All Warehouses	15.60	0.00	2.60	1.20	0.20	2.80	22.40

Table 8-5: Natural Gas Energy Intensities (kBtu/ft^2-yr) by Building Type and End Use

Building Type	Total	Heat	Cool	WH	Cook	Misc.	Proc.
All Commercial	26.00	9.50	0.40	8.30	5.90	0.50	1.50
Small Office	10.50	8.60	0.00	1.70	0.10	0.00	0.10
Large Office	21.90	17.20	0.50	2.60	0.20	0.10	1.20
Restaurant	210.00	7.70	0.00	48.60	153.30	0.00	0.30
Retail	4.60	3.00	0.00	0.80	0.50	0.30	0.00
Food Store	27.60	9.50	0.00	7.70	10.30	0.00	0.10
Refrigerated Warehouse	5.60	0.80	0.00	0.80	1.20	0.00	2.80
Unrefrigerated Warehouse	3.10	2.70	0.00	0.30	0.00	0.00	0.00
School	16.00	10.00	0.10	4.70	1.10	0.00	0.10
College	34.20	19.80	3.50	8.40	1.70	0.90	0.00
Health	75.50	32.70	1.60	31.40	3.40	1.40	5.10
Lodging	42.40	7.30	0.10	29.00	4.40	1.40	0.30
Miscellaneous	23.30	7.00	0.40	9.30	1.00	1.00	4.60
All Offices	17.90	14.20	0.40	2.30	0.20	0.10	0.80
All Warehouses	3.40	2.40	0.00	0.40	0.20	0.00	0.40

8.3 Segment-Level Fuel Shares, EUIs, and Energy Intensities

This section provides EUIs, fuel shares, and energy intensities for the building types and end uses defined in Chapter 7. Results are not presented in this section for the "All Offices" and "All Warehouses" building types.

All Commercial

Estimated total floor stock for all commercial buildings is 4.9 billion square feet. Electric and natural gas EUIs, fuel shares and energy intensities (EIs) for the overall commercial sector are presented in Table 8-6 and Table 8-7.

Table 8-6: All Commercial Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.53	41.40	0.22
Cooling	2.97	68.60	2.04
Ventilation	2.16	75.10	1.63
Water Heating	0.27	45.70	0.12
Cooking	0.62	91.50	0.57
Refrigeration	1.94	94.40	1.83
Interior Lighting	3.92	99.90	3.92
Office Equipment	0.99	98.40	0.97
Exterior Lighting	0.89	89.60	0.80
Miscellaneous	0.87	91.30	0.80
Process	1.91	2.20	0.04
Motors	0.99	57.70	0.57
Air Compressors	0.36	36.60	0.13
All End Uses			13.63

Table 8-7: All Commercial Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	16.91	55.9	9.46
Cooling	25.68	1.50	0.39
Water Heating	14.47	57.10	8.27
Cooking	20.66	28.40	5.88
Miscellaneous	4.36	10.70	0.47
Process	46.92	3.30	1.53
All End Uses			26.00

Small Offices

Estimated statewide total floor stock in small office buildings (defined as premises with total floor area less than 30,000 square feet) is just over 361 million square feet. As shown in Table 8-8, the largest electric end uses in this building type are interior lighting, cooling, and office equipment. The predominant gas end use is space heating, as shown in Table 8-9.

Table 8-8: Small Office Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.44	45.50	0.20
Cooling	2.90	90.10	2.61
Ventilation	1.41	91.40	1.29
Water Heating	0.41	60.40	0.25
Cooking	0.11	93.10	0.10
Refrigeration	0.61	93.80	0.58
Interior Lighting	3.83	100.00	3.83
Office Equipment	2.21	99.40	2.19
Exterior Lighting	1.28	73.70	0.95
Miscellaneous	0.99	79.00	0.78
Process	0.76	0.40	0.00
Motors	0.99	22.00	0.22
Air Compressors	0.58	17.10	0.10
All End Uses			13.10

Table 8-9: Small Office Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	17.40	49.50	8.62
Cooling	0.00	0.00	0.00
Water Heating	5.23	31.70	1.66
Cooking	3.86	3.20	0.12
Miscellaneous	1.37	2.90	0.04
Process	67.08	0.10	0.10
All End Uses			10.54

Large Offices

Estimated total floor stock in large office buildings (defined as premises with total floor area of 30,000 square feet or more) is just over 660 million square feet. Table 8-10 shows that interior lighting, office equipment, and cooling are the largest electric end uses in this building type. As shown in Table 8-11, the predominant gas end use is space heating.

Table 8-10: Large Office Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.63	77.10	0.49
Cooling	3.87	92.20	3.57
Ventilation	3.24	94.40	3.06
Water Heating	0.24	51.30	0.12
Cooking	0.12	98.00	0.12
Refrigeration	0.41	98.30	0.41
Interior Lighting	4.46	100.00	4.46
Office Equipment	3.58	100.00	3.58
Exterior Lighting	0.51	96.00	0.49
Miscellaneous	0.65	89.80	0.58
Process	1.60	1.70	0.03
Motors	0.80	89.60	0.72
Air Compressors	0.15	60.90	0.09
All End Uses			17.70

Table 8-11: Large Office Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	23.35	73.80	17.22
Cooling	27.92	1.90	0.54
Water Heating	4.43	58.70	2.60
Cooking	1.35	17.40	0.23
Miscellaneous	1.84	5.60	0.10
Process	65.11	1.90	1.23
All End Uses			21.92

Restaurants

Estimated total floor stock in restaurants is just over 148 million square feet. As shown in Table 8-12, the largest electric end uses in this building type are cooking, refrigeration, and interior lighting. Table 8-13 shows that cooking and water heating are the major gas end uses.

Table 8-12: Restaurant Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.34	14.30	0.05
Cooling	8.22	70.10	5.76
Ventilation	4.21	76.80	3.24
Water Heating	2.22	17.00	0.38
Cooking	10.44	99.50	10.38
Refrigeration	9.87	100.00	9.87
Interior Lighting	6.45	100.00	6.45
Office Equipment	0.64	98.50	0.63
Exterior Lighting	2.36	85.60	2.02
Miscellaneous	1.39	81.00	1.13
Process	1.21	0.50	0.01
Motors	1.37	20.00	0.27
Air Compressors	0.62	2.90	0.02
All End Uses			40.20

Table 8-13: Restaurant Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	13.45	57.60	7.75
Cooling	0.00	0.00	0.00
Water Heating	55.86	87.00	48.61
Cooking	177.85	86.20	153.29
Miscellaneous	1.34	0.50	0.01
Process	42.59	0.80	0.33
All End Uses			209.99

Retail

Estimated total floor stock for this building type is just over 702 million square feet. As shown in Table 8-14, the predominant electric end use in this building type is interior lighting, although cooling and ventilation account for a substantial portion of usage. Table 8-15 shows that space heating accounts for most of natural gas consumption in the retail sector.

Table 8-14: Retail Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.36	22.00	0.08
Cooling	3.03	72.90	2.21
Ventilation	2.35	76.90	1.81
Water Heating	0.25	55.50	0.14
Cooking	0.26	87.30	0.22
Refrigeration	1.15	89.90	1.03
Interior Lighting	6.05	100.00	6.05
Office Equipment	0.49	99.90	0.49
Exterior Lighting	1.11	82.60	0.92
Miscellaneous	0.80	85.90	0.69
Process	3.30	1.60	0.05
Motors	0.71	40.20	0.29
Air Compressors	0.39	23.20	0.09
All End Uses			14.06

Table 8-15: Retail Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	6.67	45.30	3.02
Cooling	0.00	0.00	0.00
Water Heating	2.51	31.10	0.78
Cooking	8.67	6.00	0.52
Miscellaneous	10.48	2.50	0.27
Process	5.58	0.60	0.04
All End Uses			4.63

Food Stores

Estimated total floor stock for this building type is approximately 144 million square feet. Table 8-16 shows that refrigeration is the largest electric end use in this building type, with interior lighting comprising about half of remaining usage. As shown in Table 8-17, cooking, space heating, and water heating all account for significant shares of gas consumption.

Table 8-16: Food Store Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.55	14.90	0.08
Cooling	4.54	63.40	2.88
Ventilation	3.82	67.60	2.58
Water Heating	0.51	26.60	0.14
Cooking	2.17	85.10	1.85
Refrigeration	22.42	100.00	22.42
Interior Lighting	8.55	100.00	8.55
Office Equipment	0.38	98.70	0.37
Exterior Lighting	1.05	90.20	0.95
Miscellaneous	1.02	93.60	0.95
Process	1.14	0.70	0.01
Motors	0.51	34.60	0.18
Air Compressors	0.47	8.70	0.04
All End Uses			40.99

Table 8-17: Food Store Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	19.71	48.30	9.51
Cooling	0.00	0.00	0.00
Water Heating	10.77	71.10	7.66
Cooking	21.01	49.20	10.35
Miscellaneous	0.87	2.00	0.02
Process	9.83	0.70	0.07
All End Uses			27.61

Refrigerated Warehouses

Estimated total floor stock for this building type is approximately 95 million square feet. Table 8-18 shows that refrigeration is the largest electric end use in this building type, accounting for roughly two-thirds of total electric usage. As shown in Table 8-19, the largest gas EUI is process, although the process gas energy intensity is low.

Table 8-18: Refrigerated Warehouse Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.58	3.80	0.02
Cooling	2.68	12.20	0.33
Ventilation	1.85	13.20	0.24
Water Heating	0.05	57.30	0.03
Cooking	0.04	86.50	0.04
Refrigeration	13.44	100.00	13.44
Interior Lighting	2.74	100.00	2.74
Office Equipment	0.18	99.10	0.17
Exterior Lighting	0.35	97.40	0.35
Miscellaneous	0.60	96.40	0.57
Process	1.13	3.80	0.04
Motors	2.29	79.50	1.82
Air Compressors	0.31	73.60	0.23
All End Uses			20.02

Table 8-19: Refrigerated Warehouse Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	9.58	8.30	0.79
Cooling	0.00	0.00	0.00
Water Heating	1.91	41.50	0.79
Cooking	14.95	8.20	1.22
Miscellaneous	0.24	2.90	0.01
Process	22.67	12.30	2.78
All End Uses			5.59

Unrefrigerated Warehouses

Estimated total floor stock for this building type is over 554 million square feet. As shown in Table 8-20, the overall electric energy intensity in this building type is low, with interior lighting accounting for roughly half of electric usage. Table 8-21 shows that gas energy intensity is also low, with space heating being the predominant gas end.

Table 8-20: Unrefrigerated Warehouse Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.35	10.20	0.04
Cooling	1.48	22.40	0.33
Ventilation	1.03	27.40	0.28
Water Heating	0.07	70.50	0.05
Cooking	0.02	90.70	0.02
Refrigeration	0.30	92.00	0.28
Interior Lighting	2.21	100.00	2.21
Office Equipment	0.24	99.00	0.24
Exterior Lighting	0.28	92.50	0.26
Miscellaneous	0.41	94.70	0.39
Process	0.91	1.80	0.02
Motors	0.59	49.90	0.29
Air Compressors	0.16	35.60	0.06
All End Uses			4.45

Table 8-21: Unrefrigerated Warehouse Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	12.32	21.70	2.68
Cooling	0.00	0.00	0.00
Water Heating	0.94	34.70	0.32
Cooking	0.64	2.00	0.01
Miscellaneous	0.83	4.40	0.04
Process	3.29	0.60	0.02
All End Uses			3.07

Schools

Estimated total floor stock for this building type is just over 445 million square feet. According to Table 8-22, interior lighting, cooling, and ventilation are the largest electric end uses in this building type. Table 8-23 shows that space heating is the major gas end use.

Table 8-22: School Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.20	62.00	0.13
Cooling	1.50	78.10	1.17
Ventilation	1.01	95.00	0.96
Water Heating	0.21	47.10	0.10
Cooking	0.18	97.80	0.18
Refrigeration	0.51	99.30	0.50
Interior Lighting	2.88	100.00	2.88
Office Equipment	0.46	100.00	0.46
Exterior Lighting	0.76	97.50	0.74
Miscellaneous	0.26	94.80	0.25
Process	0.04	4.00	0.00
Motors	0.19	43.70	0.08
Air Compressors	0.08	18.10	0.01
All End Uses			7.46

Table 8-23: School Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	11.47	87.30	10.01
Cooling	7.74	1.60	0.12
Water Heating	5.26	89.10	4.69
Cooking	1.61	65.50	1.05
Miscellaneous	0.36	8.40	0.03
Process	6.88	0.90	0.06
All End Uses			15.96

Colleges

Estimated total floor stock for this building type is approximately 206 million square feet. Table 8-24 shows that interior lighting, ventilation, and cooling are the largest electric end uses in this building type. Space heating accounts for most of the gas usage in this sector, as shown in Table 8-25.

Table 8-24: College Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.96	80.30	0.77
Cooling	2.35	81.30	1.91
Ventilation	2.28	90.20	2.05
Water Heating	0.24	51.30	0.12
Cooking	0.32	84.40	0.27
Refrigeration	0.51	90.10	0.46
Interior Lighting	3.84	100.00	3.84
Office Equipment	0.72	100.00	0.72
Exterior Lighting	0.95	96.30	0.91
Miscellaneous	0.50	96.10	0.49
Process	0.37	2.40	0.01
Motors	0.65	88.80	0.58
Air Compressors	0.20	69.70	0.14
All End Uses			12.26

Table 8-25: College Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	24.15	82.10	19.83
Cooling	16.71	20.70	3.46
Water Heating	10.63	79.10	8.41
Cooking	3.69	45.10	1.66
Miscellaneous	2.29	37.60	0.86
Process	0.67	2.80	0.02
All End Uses			34.24

Health

Estimated total floor stock for this building type is approximately 232 million square feet. Table 8-26 indicates that the largest electric end uses in this building type are interior lighting, ventilation and cooling. As seen in Table 8-27, heating and water heating account for the major shares of gas usage.

Table 8-26: Health Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.98	72.80	0.71
Cooling	4.29	90.30	3.87
Ventilation	4.23	95.50	4.04
Water Heating	0.36	21.50	0.08
Cooking	0.44	99.10	0.43
Refrigeration	0.71	99.80	0.71
Interior Lighting	4.81	100.00	4.81
Office Equipment	0.86	99.90	0.86
Exterior Lighting	0.58	97.50	0.57
Miscellaneous	2.54	99.10	2.52
Process	0.26	2.00	0.01
Motors	1.05	74.10	0.78
Air Compressors	0.42	51.60	0.22
All End Uses			19.61

Table 8-27: Health Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	38.18	85.70	32.70
Cooling	69.62	2.20	1.55
Water Heating	35.53	88.30	31.37
Cooking	4.48	75.20	3.37
Miscellaneous	4.20	34.40	1.45
Process	22.31	22.80	5.09
All End Uses			75.53

Lodging

Estimated total floor stock for this building type is approximately 270 million square feet. As shown in Table 8-28, the biggest single end use in this sector is interior lighting, followed by cooling and ventilation. Table 8-29 indicates that water heating accounts for most of the gas consumption.

Table 8-28: Lodging Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.49	86.20	0.42
Cooling	2.82	85.40	2.41
Ventilation	1.92	93.10	1.79
Water Heating	1.00	3.30	0.03
Cooking	0.72	94.70	0.68
Refrigeration	0.91	99.70	0.90
Interior Lighting	3.50	100.00	3.50
Office Equipment	0.18	96.20	0.17
Exterior Lighting	0.66	92.90	0.61
Miscellaneous	1.12	99.10	1.11
Process	0.00	0.00	0.00
Motors	0.52	91.30	0.48
Air Compressors	0.06	33.60	0.02
All End Uses			12.13

Table 8-29: Lodging Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	12.25	59.50	7.28
Cooling	17.32	0.40	0.07
Water Heating	32.20	89.90	28.95
Cooking	7.60	58.10	4.42
Miscellaneous	2.66	53.60	1.43
Process	3.96	6.50	0.26
All End Uses			42.41

Miscellaneous

Estimated total floor stock for this building type is approximately 1.1 billion square feet. As shown in Table 8-30, interior lighting is the largest electric end use in this building type, with remaining electric usage spread out over several other end uses. Table 8-31 shows that heating and water heating account for most of the gas consumption in this diverse building type, with process uses accounting for most of the rest of consumption.

Table 8-30: Miscellaneous Electric EUIs, Fuel Shares, and EIs

End Use	Electric EUI (kWh/End-Use ft^2)	Electric Fuel Share	Electric EI (kWh/ft^2)
Heating	0.39	23.90	0.09
Cooling	1.89	58.30	1.10
Ventilation	1.26	67.80	0.86
Water Heating	0.35	37.90	0.13
Cooking	0.30	86.70	0.26
Refrigeration	0.95	90.70	0.86
Interior Lighting	2.63	99.50	2.61
Office Equipment	0.37	94.80	0.35
Exterior Lighting	1.23	86.70	1.07
Miscellaneous	1.08	92.60	1.00
Process	3.23	3.60	0.12
Motors	1.81	59.90	1.08
Air Compressors	0.72	41.50	0.30
All End Uses			9.84

Table 8-31: Miscellaneous Natural Gas EUIs, Fuel Shares, and EIs

End Use	Natural Gas EUI (kBtu/End-Use ft^2)	Natural Gas Fuel Share	Natural Gas EI (kBtu/ft^2)
Heating	13.65	51.60	7.04
Cooling	73.53	0.50	0.37
Water Heating	16.61	56.30	9.34
Cooking	3.77	27.00	1.02
Miscellaneous	12.02	8.20	0.99
Process	111.22	4.10	4.58
All End Uses			23.34

8.4 Segment-Level Hourly End-Use Electric Shapes

This section presents 16-day hourly stacked end-use graphs from DrCEUS for the basic set of building types (that is, excluding “All Offices” and “All Warehouses”). The 16-day type basis (4 day types X 4 seasons), as defined in Chapter 7, are as follows:

- **Four Day Types.** Typical Day (weekday), Hot Day (weekday), Cold Day (weekday) and Weekend (Saturday, Sunday, and holidays). Note that the Hot and Cold day types are the hottest\coldest[1] *single* days during a season, whereas the Typical and Weekend day types are an *average* of all days of those respective types during the season.
- ***Four Seasons.*** Winter (December through February), Spring (March through May), Summer (June through September), Fall (October through November).

Only electric hourly end-use shapes are presented here, although gas end-use hourly shapes are also available from DrCEUS.

[1] The hottest/coldest days are determined as the first weekday during a season that has the highest or lowest hourly temperature.

Figure 8-5: All Commercial 16-Day Hourly End-Use Shapes

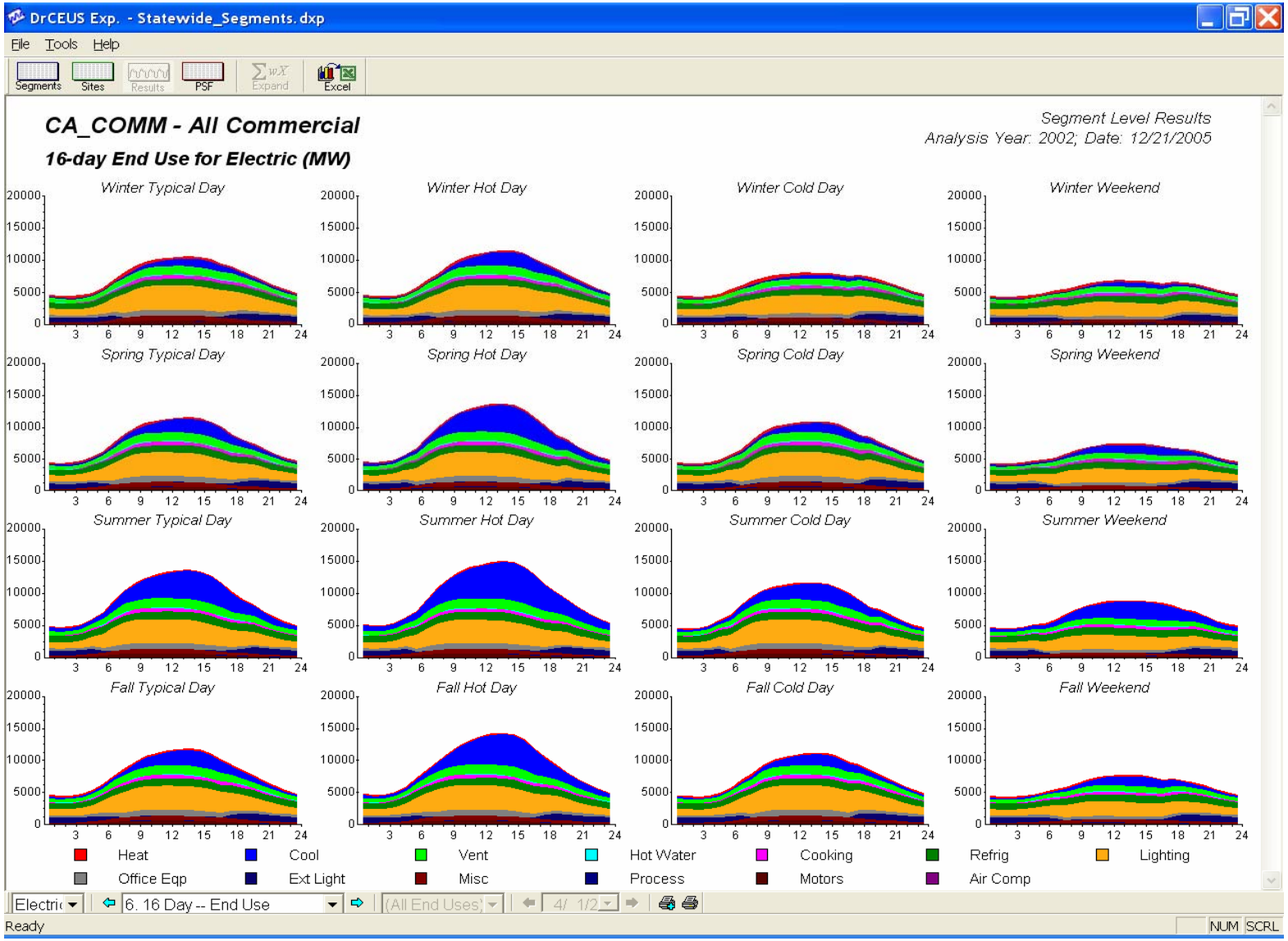

Figure 8-6: Small Office 16-Day Hourly End-Use Shapes

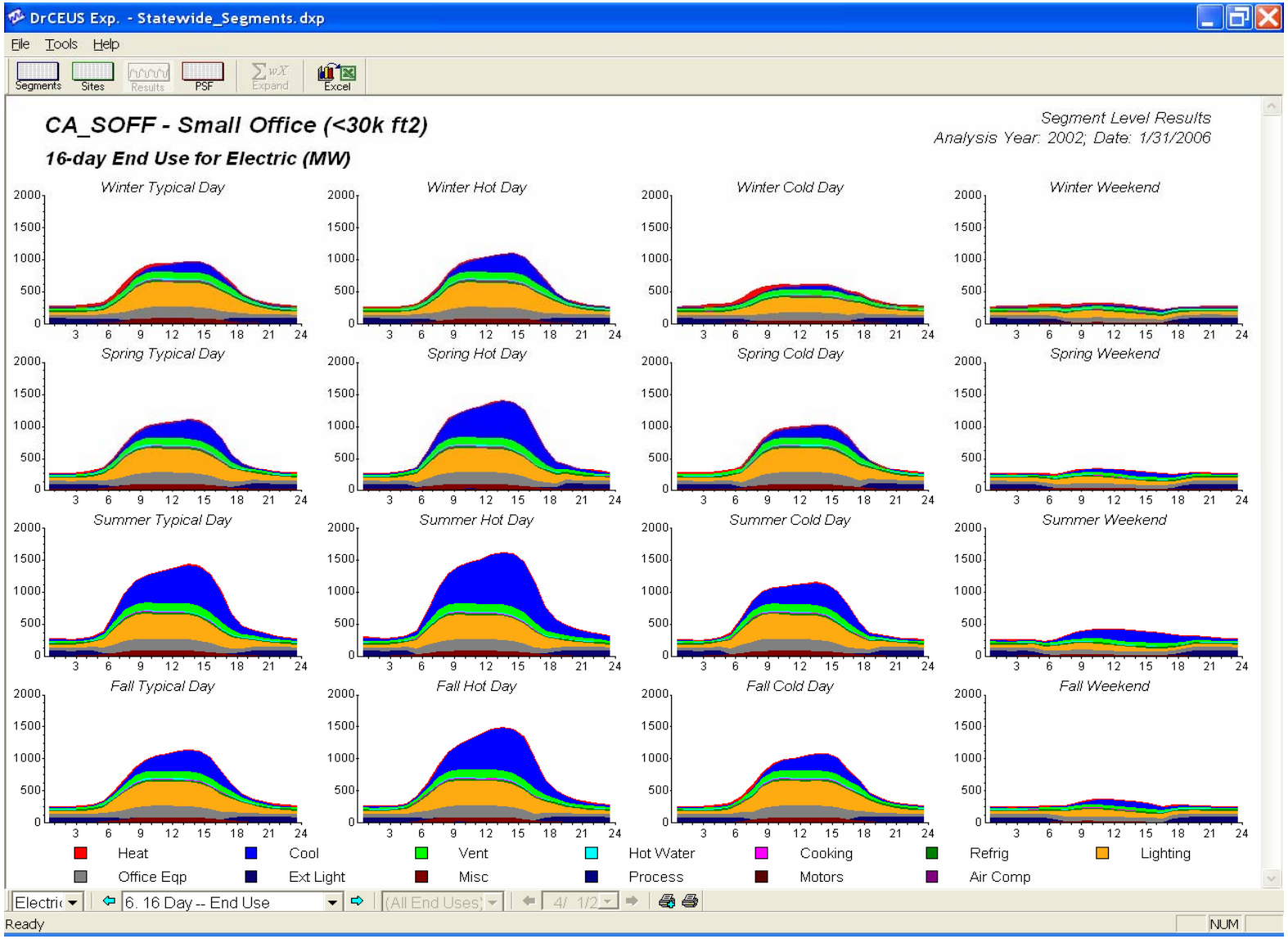

Figure 8-7: Large Office 16-Day Hourly End-Use Shapes

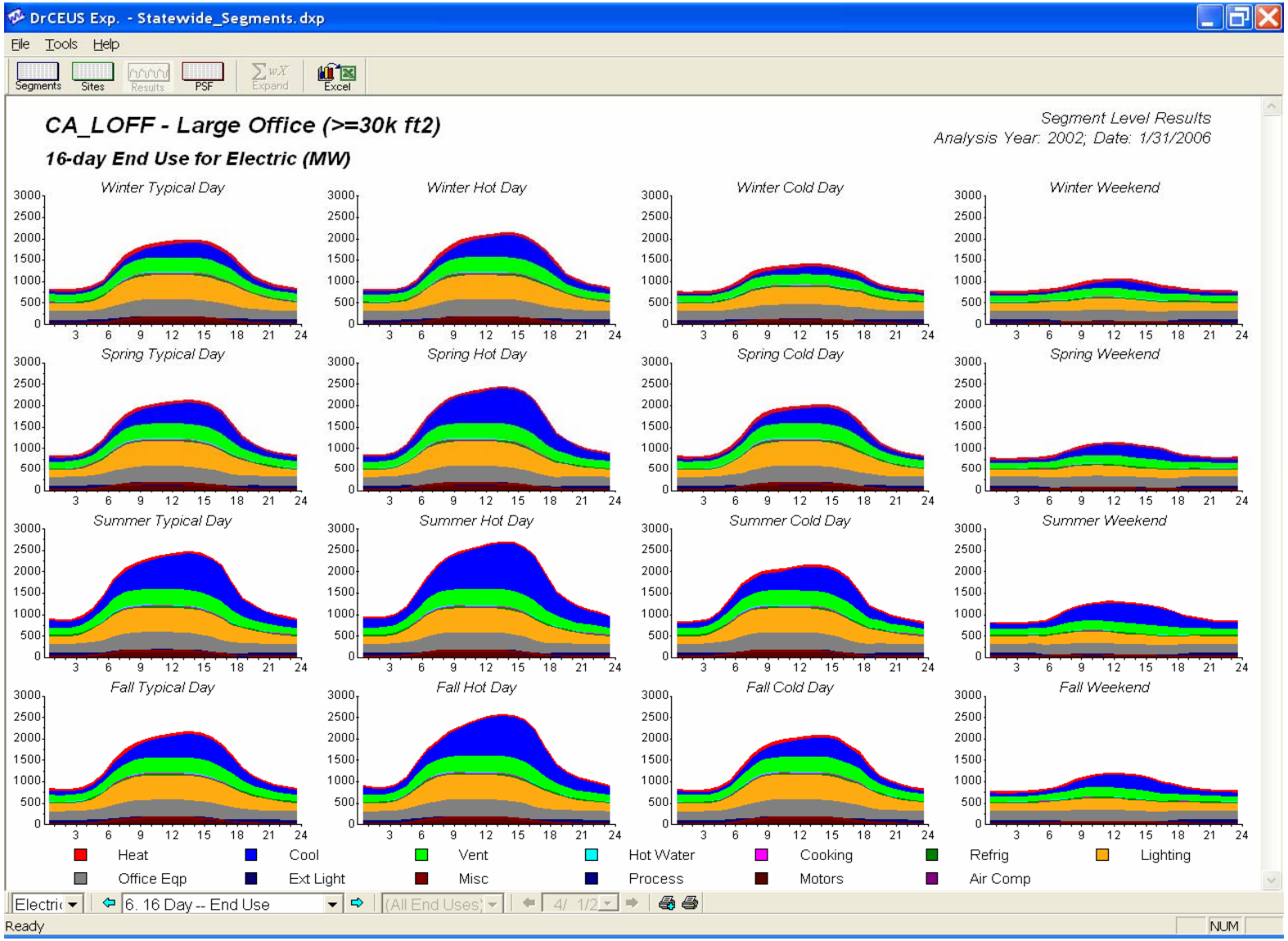

Figure 8-8: Restaurant 16-Day Hourly End-Use Shapes

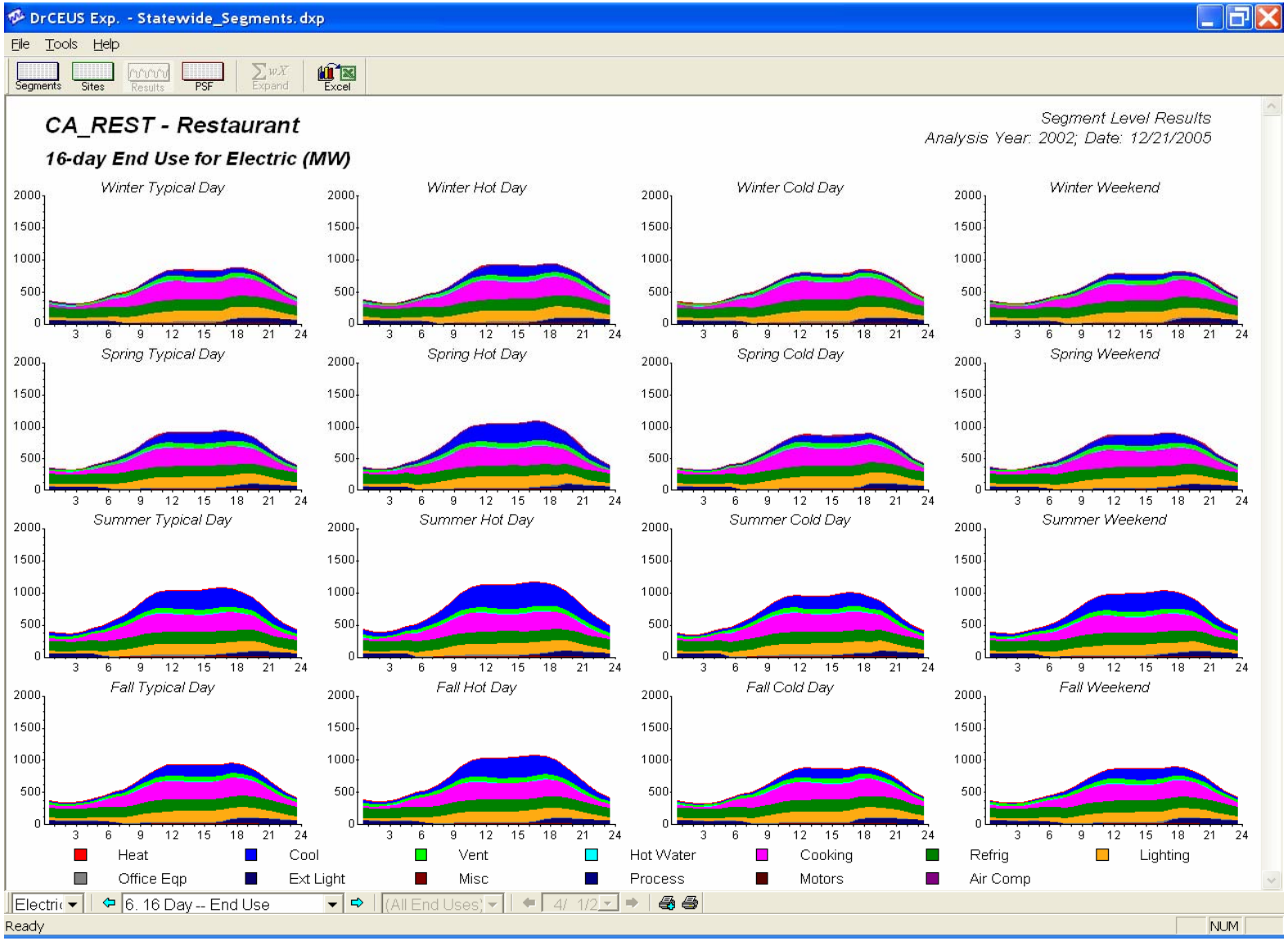

Figure 8-9: Retail 16-Day Hourly End-Use Shapes

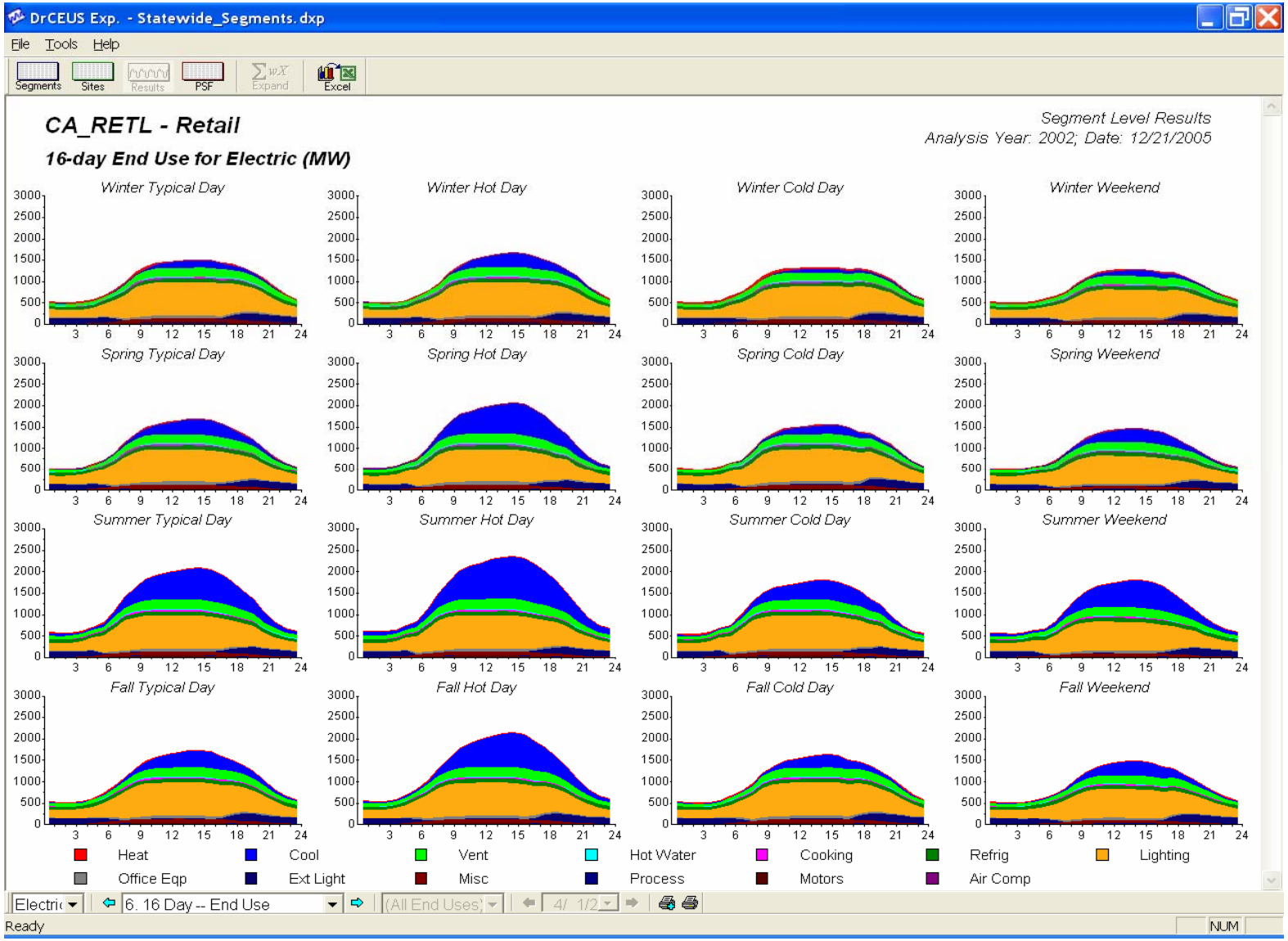

Figure 8-10: Food Store 16-Day Hourly End-Use Shapes

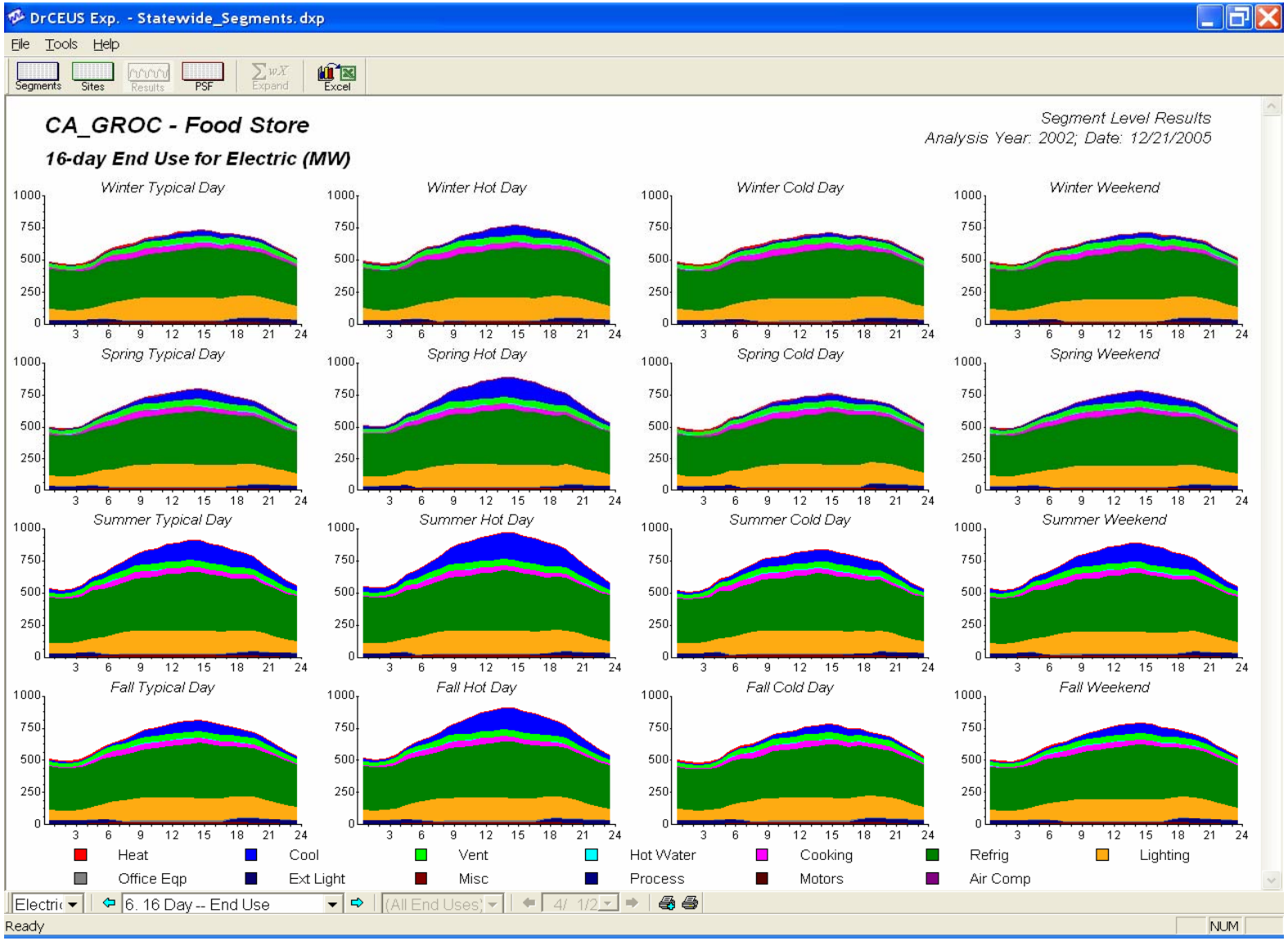

Figure 8-11: Refrigerated Warehouse 16-Day Hourly End-Use Shapes

Figure 8-12: Unrefrigerated Warehouse 16-Day Hourly End-Use Shapes

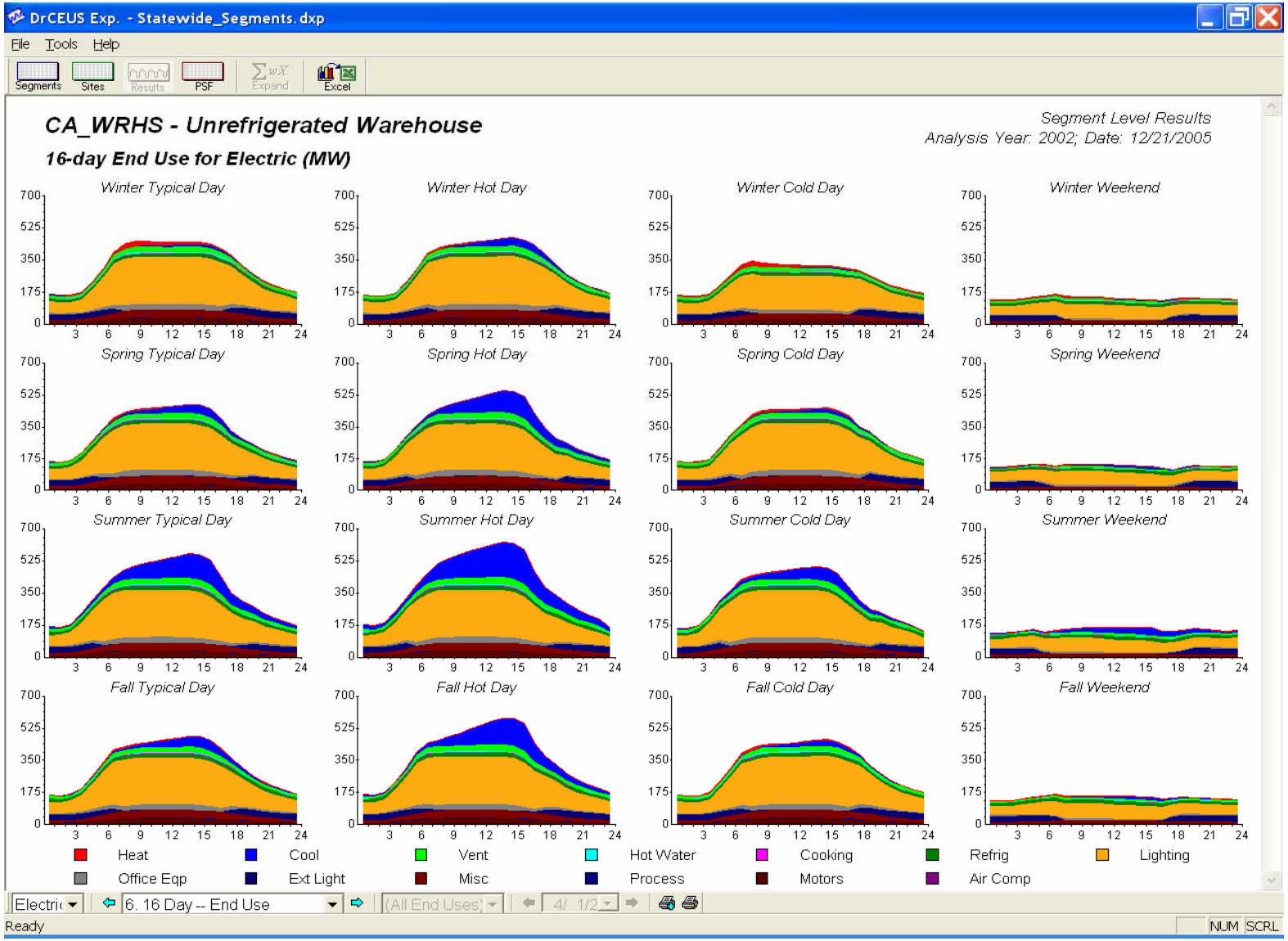

Figure 8-13: School 16-Day Hourly End-Use Shapes

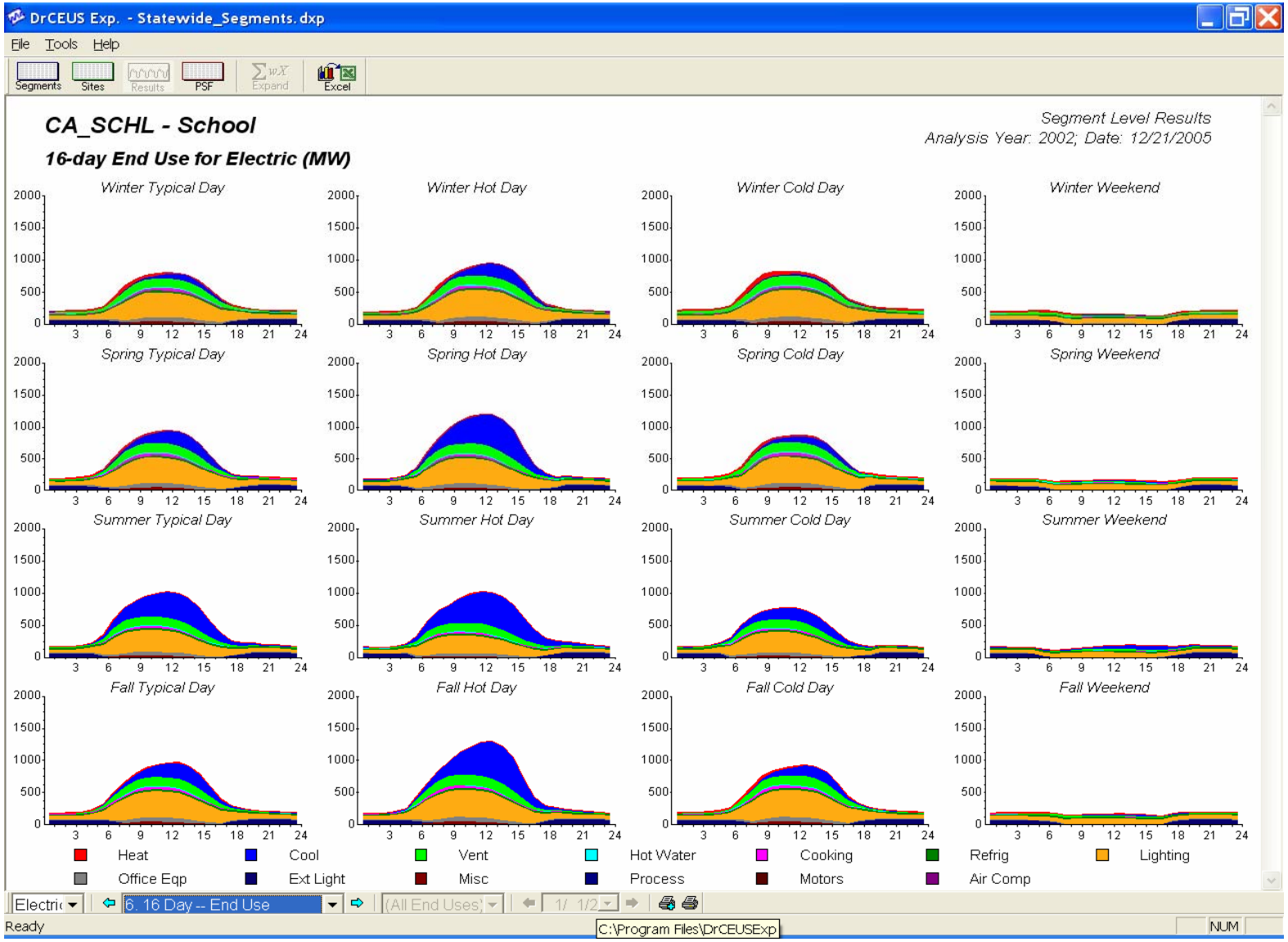

Figure 8-14: College 16-Day Hourly End-Use Shapes

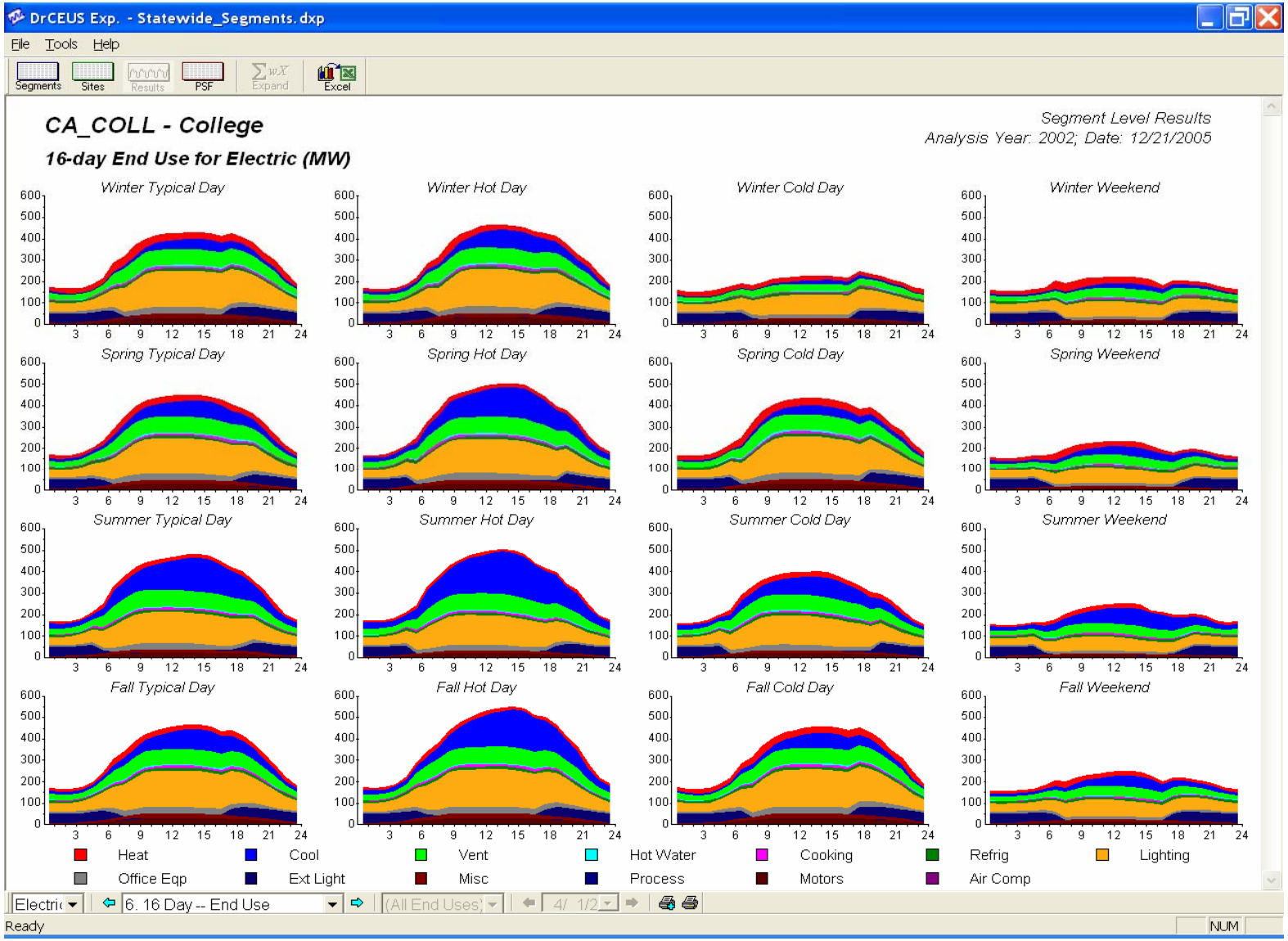

Figure 8-15: Health 16-Day Hourly End-Use Shapes

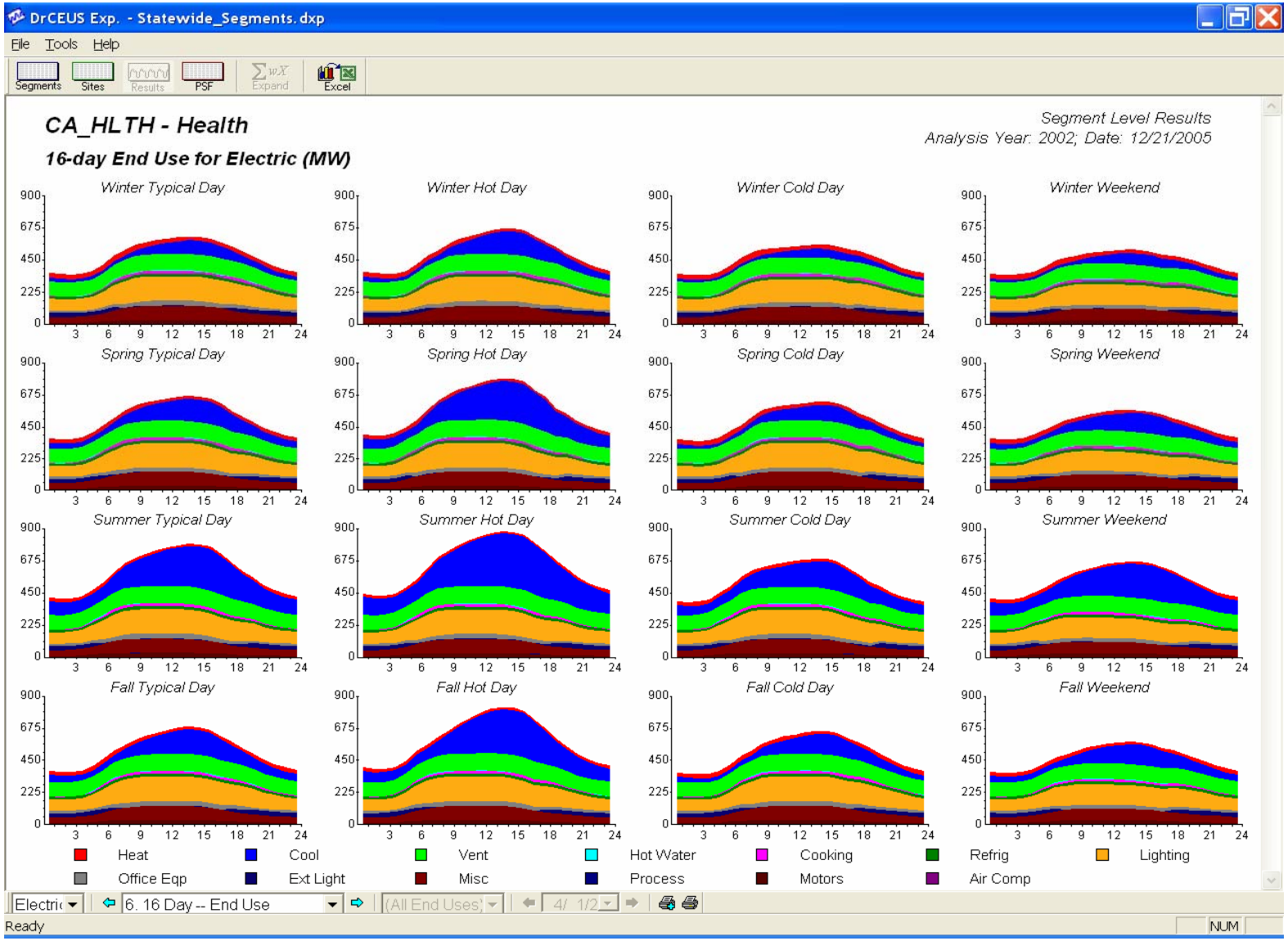

Figure 8-16: Lodging 16-Day Hourly End-Use Shapes

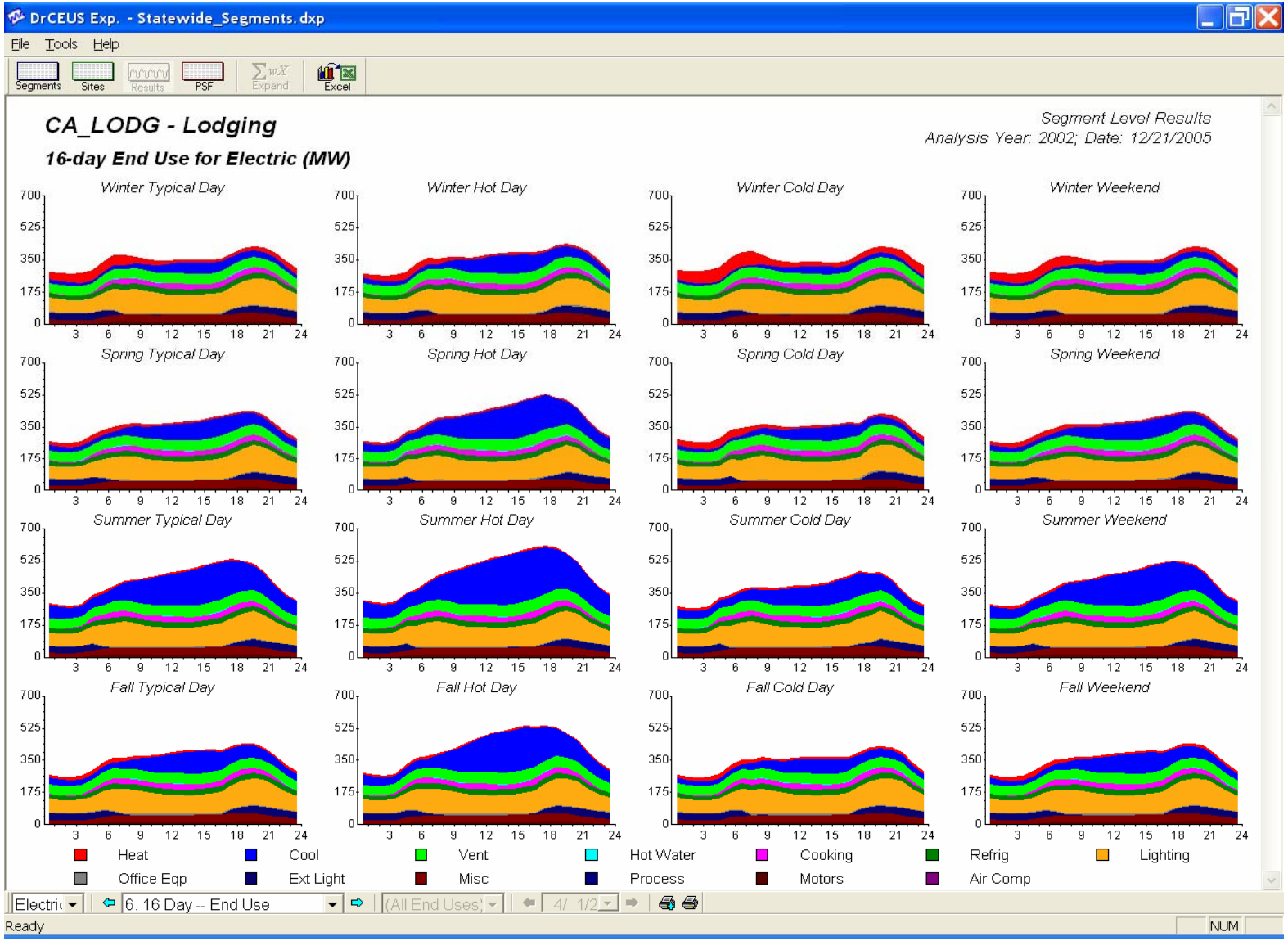

Figure 8-17: Miscellaneous 16-Day Hourly End-Use Shapes