

CALIFORNIA COMMERCIAL END-USE SURVEY

Chapter 9

CONSULTANT REPORT

Prepared For:
California Energy Commission

CALMAC Study ID: CEC0023.05

Prepared By:
Itron, Inc.



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.

Prepared By:

Itron, Inc.

Subcontractors:

KEMA

ADM Associates

James J. Hirsch & Associates

Contract No. 300-00-002

Prepared For:

California Energy Commission

Peg A. Pigeon-Bergmann

Contract Manager

Mohsen Abrishami

Mark Ciminelli

Project Managers

Sylvia Bender

Manager

Demand Analysis Office

Valerie Hall

Deputy Director

Energy Efficiency & Demand Analysis Division

B.B. Blevins

Executive Director

DISCLAIMER

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.

TABLE OF CONTENTS

| | |
|---|-----------|
| Executive Summary | 1 |
| E.1 Introduction | 1 |
| Overview | 1 |
| Background | 1 |
| Project Objectives | 1 |
| E.2 Summary of the Project Scope and Methods | 2 |
| Survey Design | 2 |
| Collection of On-Site Survey Data | 2 |
| Collection of Information on Energy Usage for Sampled Sites | 2 |
| Development of Demand Analysis System | 3 |
| Analysis of Hourly End-Use Energy Consumption at the Premise Level | 3 |
| Analysis of Segment-Level End-Use Energy Consumption | 4 |
| E.3 Overview of Statewide Energy Usage | 5 |
| Definitions | 5 |
| Results | 7 |
| E.4 Recommendations | 14 |
| Lessons Learned | 14 |
| Recommendations for Additional Commercial Sector Research | 15 |
| | |
| Chapter 1: Introduction | 17 |
| 1.1 Overview | 17 |
| 1.2 Background | 17 |
| 1.3 Project Objectives | 17 |
| 1.4 Summary of the Study | 18 |
| Survey Design | 18 |
| Collection of On-Site Survey Data | 18 |
| Development of Energy Consumption Data for Sampled Sites | 19 |
| Development of Demand Analysis System | 19 |
| Analysis of Premise-Level End-Use Energy Consumption | 20 |
| Analysis of Segment-Level End-Use Energy Consumption | 21 |
| 1.5 Organization of the Report | 22 |
| CEUS Report Structure | 22 |
| CEUS Report Appendices | 22 |
| Affiliated Reports from the CEUS Project | 23 |
| | |
| Chapter 2: Sample Design | 25 |
| 2.1 Overview | 25 |
| 2.2 Sampling Unit | 25 |
| 2.3 Sample Frame for IOU Survey | 26 |
| 2.4 Sample Frame Stratification | 28 |
| 2.5 Sample Size and Sample Allocation | 31 |
| Sample Size | 31 |

| | |
|--|-----------|
| Sample Allocation | 31 |
| 2.6 Development of Final Sample Design for IOU Survey | 33 |
| Allocation Methods | 33 |
| Alternative Stratification Approaches | 34 |
| Final Sample Design..... | 36 |
| 2.7 SMUD Sample Design | 41 |
| Sample Frame | 41 |
| SMUD Sample Design..... | 42 |
| Chapter 3: Survey Design and Implementation..... | 45 |
| 3.1 Overview | 45 |
| 3.2 Survey Instrument Design | 45 |
| Non-HVAC Equipment End-use Mapping | 46 |
| Energy Efficiency Measure Detail | 46 |
| eQUEST Design Development Wizard Features | 47 |
| 3.3 Customer Recruitment Protocols | 48 |
| Introduction | 48 |
| Recruitment Letter | 49 |
| Recruitment Phone Calls | 49 |
| Recruitment Disposition Report Requirements | 51 |
| 3.4 Survey Protocols | 54 |
| Introduction | 54 |
| Premise as the Unit of Analysis | 55 |
| Protocols for Linking Meters to Premises..... | 55 |
| Defining Component Survey Areas..... | 55 |
| Protocols for Determining Business Type | 57 |
| Protocols for Dealing with Large Sites and Limited Access | 57 |
| Describing HVAC Zoning, Mechanical Systems and Equipment for HVAC and non HVAC End Uses | 60 |
| Site Physical Characteristics..... | 61 |
| Recording Technical Information | 62 |
| Supplemental Information | 63 |
| Key Elements of Business Operations..... | 63 |
| Interview Techniques..... | 64 |
| Quality-Control Procedures for Field Surveyors..... | 65 |
| 3.5 Short-Term Metering Protocols..... | 66 |
| Overall STM Objectives | 66 |
| STM Targets | 66 |
| General Issues/Protocols..... | 70 |
| 3.6 Surveyor Training..... | 71 |
| Day 1 | 71 |
| Day 2-3 | 72 |
| Day 4 | 72 |
| 3.7 Survey Pretests | 72 |
| 3.8 Survey Implementation Process | 73 |
| Overall Process | 73 |

| | |
|--|------------|
| Initial Sample | 74 |
| Recruiting Protocol | 75 |
| Site Information Sheets..... | 75 |
| Weekly Disposition Reports | 75 |
| Quality Control Procedures..... | 76 |
| Data Entry..... | 76 |
| Data Cleaning | 79 |
| On-Site Survey Form Delivery | 79 |
| Inventory Reports | 79 |
| 3.9 Completed Samples | 79 |
| On-Site Survey Sample Targets and Actual Counts | 80 |
| Premises with Interval-Metered Data Available | 81 |
| Premises with Short-Term Metering Data | 82 |
| Chapter 4: Electric and Natural Gas Consumption Data | 85 |
| 4.1 Overview | 85 |
| 4.2 Validation and Analysis of Billing Data | 86 |
| 4.3 Calendarization of Consumption Data..... | 87 |
| 4.4 Developing Sample Recruitment Pools..... | 88 |
| 4.5 Gas Consumption for SCE and SMUD Premises..... | 89 |
| 4.6 Customer Information Sheet (CIS)..... | 90 |
| 4.7 Meter Reconciliation Issues | 92 |
| 4.8 Mapping Interval-Metered Data to Premises | 92 |
| 4.9 Post-Survey Meter Reconciliation | 93 |
| Chapter 5: Simulation Modeling Software | 95 |
| 5.1 Introduction | 95 |
| 5.2 DrCEUS System Design Overview..... | 95 |
| 5.3 Site Processing Mode | 97 |
| Site Processor Structure | 97 |
| Site Processor Results..... | 98 |
| Energy Efficiency Measure Analysis in the Site Processor | 101 |
| Utility Billing Analysis in the Site Processor | 103 |
| 5.4 Segment Processing Mode..... | 104 |
| 5.5 Applications of the CEUS Database and DrCEUS | 106 |
| Chapter 6: The DRCEUS Energy Simulation And Calibration Process | 109 |
| 6.1 Overview | 109 |
| 6.2 Simulation Weather Data | 109 |
| 6.3 Calibration Data Sources..... | 111 |
| Electric and Gas Consumption Data..... | 111 |
| Interval-Metered Electricity Data | 112 |
| Short-Term Metered (STM) Data | 112 |
| 6.4 DrCEUS Simulation and Calibration Process | 114 |
| Overview of the Simulation/Calibration Process | 114 |

| | |
|---|------------|
| Figure 6-4: Overview of the DrCEUS Simulation/Calibration Process | 114 |
| 6.5 Judgmental Calibration..... | 115 |
| 6.6 Calibration Special Issues | 120 |
| Complex Building Systems | 120 |
| Billed Demand Data | 121 |
| Interval-Metered Data | 122 |
| Short-Term Metered (STM) Data | 122 |
| Propane and Non-IOU Commercial Natural Gas | 123 |
| Chapter 7: Analysis of Commercial Segments—Key Concepts | 125 |
| 7.1 Overview | 125 |
| 7.2 Expansion (Case) Weights | 125 |
| 7.3 Definitions and Concepts | 140 |
| 7.4 Presentation of Results | 145 |
| Chapter 8: Statewide Results by Segment | 149 |
| 8.1 Introduction | 149 |
| 8.2 Overview of Statewide Energy Usage | 149 |
| 8.3 Segment-Level Fuel Shares, EUIs, and Energy Intensities..... | 156 |
| All Commercial..... | 156 |
| Small Offices..... | 157 |
| Large Offices | 158 |
| Restaurants | 159 |
| Retail..... | 160 |
| Food Stores | 161 |
| Refrigerated Warehouses | 162 |
| Unrefrigerated Warehouses..... | 163 |
| Schools | 164 |
| Colleges..... | 165 |
| Health | 166 |
| Lodging | 167 |
| Miscellaneous | 168 |
| 8.4 Segment-Level Hourly End-Use Electric Shapes | 169 |
| Chapter 9: PG&E Results by Segment..... | 183 |
| 9.1 Introduction | 183 |
| 9.2 Overview of Energy Usage in the PG&E Electric Service Area | 183 |
| 9.3 Segment-Level Fuel Shares, EUIs, and Energy Intensities..... | 190 |
| All Commercial..... | 190 |
| Small Offices..... | 191 |
| Large Offices | 192 |
| Restaurants | 193 |
| Retail..... | 194 |
| Food Stores | 195 |
| Refrigerated Warehouses | 196 |

| | |
|--|------------|
| Unrefrigerated Warehouses | 197 |
| Schools | 198 |
| Colleges | 199 |
| Health | 200 |
| Lodging | 201 |
| Miscellaneous | 202 |
| 9.4 Segment-Level Hourly End-Use Electric Shapes | 203 |
| Chapter 10: SCE Results by Segment..... | 217 |
| 10.1 Introduction | 217 |
| 10.2 Overview of Energy Usage in the SCE Electric Service Area..... | 217 |
| 10.3 Segment-Level Fuel Shares, EUIs, and Energy Intensities..... | 224 |
| All Commercial..... | 224 |
| Small Offices..... | 225 |
| Large Offices | 226 |
| Restaurants | 227 |
| Retail..... | 228 |
| Food Stores | 229 |
| Refrigerated Warehouses | 230 |
| Unrefrigerated Warehouses..... | 231 |
| Schools | 232 |
| Colleges..... | 233 |
| Health | 234 |
| Lodging | 235 |
| Miscellaneous | 236 |
| 10.4 Segment-Level Hourly End-Use Electric Shapes | 237 |
| Chapter 11: SDG&E Results by Segment | 251 |
| 11.1 Introduction | 251 |
| 11.2 Overview of Energy Usage in the SDG&E Electric Service Area | 251 |
| 11.3 Segment-Level Fuel Shares, EUIs, and Energy Intensities..... | 258 |
| All Commercial..... | 258 |
| Small Offices..... | 259 |
| Large Offices | 260 |
| Restaurants | 261 |
| Retail..... | 262 |
| Food Stores | 263 |
| Refrigerated Warehouses | 264 |
| Unrefrigerated Warehouses..... | 265 |
| Schools | 266 |
| Colleges..... | 267 |
| Health | 268 |
| Lodging | 269 |
| Miscellaneous | 270 |
| 11.4 Segment-Level Hourly End-Use Electric Shapes | 271 |

| | |
|---|------------|
| Chapter 12: SMUD Results by Segment | 285 |
| 12.1 Introduction | 285 |
| 12.2 Overview of Energy Usage in the SMUD Electric Service Area..... | 285 |
| 12.3 Segment-Level Fuel Shares, EUIs, and Energy Intensities..... | 292 |
| All Commercial..... | 292 |
| Small Offices..... | 293 |
| Large Offices | 294 |
| Restaurants | 295 |
| Retail..... | 296 |
| Food Stores | 297 |
| Refrigerated Warehouses | 298 |
| Unrefrigerated Warehouses..... | 299 |
| Schools | 300 |
| Colleges..... | 301 |
| Health | 302 |
| Lodging | 303 |
| Miscellaneous | 304 |
| 12.4 Segment-Level Hourly End Use Electric Shapes..... | 305 |
| Chapter 13: Summary and Recommendations..... | 319 |
| 13.1 Summary of Project Scope and Methods..... | 319 |
| Survey Design | 319 |
| Collection of On-Site Survey Data | 319 |
| Collection of Information on Energy Usage for Sampled Sites | 320 |
| Development of Demand Analysis System..... | 320 |
| Analysis of Premise-Level Hourly End-Use Energy | 320 |
| Analysis of Segment-Level End-Use Energy Consumption | 321 |
| 13.2 Recommendations | 322 |
| Lessons Learned | 322 |
| Recommendations for Additional Commercial Sector Research | 324 |

Publication CEC-400-2006-005APA contains the following 10 appendices that accompany this report:

- Appendix A: Basic Survey Instrument**
- Appendix B: Annotated Survey Instrument**
- Appendix C: End-Use Mappings**
- Appendix D: Recruitment Letter**
- Appendix E: Recruitment Script**
- Appendix F: Short-Term Metering Protocols**
- Appendix G: Survey Database Layout**
- Appendix H: Non-HVAC End-Use Algorithms**
- Appendix I: Description of Forecasting Climate Zone Results Database**
- Appendix J: SIC Code to CEUS Building Type Mapping Table**

CHAPTER 9: PG&E RESULTS BY SEGMENT

9.1 Introduction

This chapter summarizes the results of the CEUS analysis for the PG&E service area. As noted in Chapter 7, *gas estimates relate to natural gas usage by commercial customers in PG&E's electric service area*. As such, they include consumption associated with some gas provided to these customers by other gas utilities, and exclude PG&E gas served to customers in other electric service areas. Section 9.2 provides an overview of the composition of energy usage in the PG&E electric service area by building type and end use. Section 9.3 presents electric and gas fuel shares, energy-use indices (EUIs), and energy intensities at the end-use level by building type. Section 9.4 provides 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 within the PG&E service area (1 through 5) were also generated. The database containing these results is described in Appendix I.

9.2 Overview of Energy Usage in the PG&E Electric Service Area

Table 9-1, Figure 9-1, and Figure 9-2 depict the estimates of floor stock, annual building energy intensities, and total annual energy usage by building type for the PG&E service area. Energy intensities and annual usage were generated using normalized weather data and 2002 as the base year. As noted in Chapter 7, these estimates represent total customer consumption rather than just purchases from utilities or other vendors.

Total commercial floor stock in the PG&E electric service area is estimated to be just under 2 billion square feet. The building types accounting for the largest percentage of total commercial floor stock are Miscellaneous (with approximately 23% of the total), Large Offices (15%), and Retail (14%).

Total commercial electric consumption is 25,506 GWh annually. The building types with the largest percentage of total electricity consumption are Large Offices (20%), Miscellaneous (17%), and retail (13%). Natural gas usage is roughly 565 million therms (Mtherms) per year. Three building types account for over 54% of natural gas usage: Restaurants (21%), Miscellaneous (20%) and Health (13%).

Figure 9-3 and Figure 9-4 depict estimates of PG&E service area electric and gas usage percentages by end use. The primary electric end uses are interior

lighting (29%), refrigeration (15%), and ventilation (12%). The primary natural gas end uses are space heating (44%) and water heating (30%).

Electric and gas usage and energy intensities for the end uses and building types described in Chapter 7 are presented in Table 9-2 through Table 9-5. As indicated in Table 9-3, for the PG&E commercial sector the highest electric end-use energy intensities are interior lighting (3.74 kWh per square foot), followed by refrigeration (1.92), ventilation (1.61) and cooling (1.60). According to Table 9-5, the highest natural gas end-use energy intensities are space heating (12.6 kBtu per square foot), water heating (8.5) and cooking (5.7).

EUIs by building type and end use are presented in Section 9-3.

Table 9-1: Overview of Energy Usage in the PG&E Electric Service Area

| Building Type | Floor Stock (kft ²) | Annual Energy Intensities | | | Total Annual Usage | |
|--------------------------|---------------------------------|------------------------------------|---------------------------------------|-------------------------------------|--------------------|-----------------------|
| | | Electricity (kWh/ft ²) | Natural Gas (therms/ft ²) | Natural Gas (kBtu/ft ²) | Electricity (GWh) | Natural Gas (Mtherms) |
| All Commercial | 1,969,884 | 12.95 | 0.29 | 28.67 | 25,506 | 564.80 |
| Small Office (<30k ft2) | 125,802 | 13.49 | 0.18 | 18.02 | 1,697 | 22.70 |
| Large Office (>=30k ft2) | 300,528 | 16.77 | 0.24 | 23.94 | 5,039 | 71.90 |
| Restaurant | 65,534 | 33.12 | 1.84 | 183.53 | 2,170 | 120.30 |
| Retail | 275,427 | 12.19 | 0.07 | 7.31 | 3,357 | 20.10 |
| Food Store | 55,797 | 40.54 | 0.34 | 34.46 | 2,262 | 19.20 |
| Refrigerated Warehouse | 60,854 | 18.5 | 0.05 | 4.5 | 1,126 | 2.70 |
| Unrefrigerated Warehouse | 156,643 | 4.87 | 0.05 | 4.88 | 763 | 7.60 |
| School | 193,432 | 6.82 | 0.22 | 21.75 | 1,319 | 42.10 |
| College | 80,661 | 11.94 | 0.37 | 37.46 | 963 | 30.20 |
| Health | 79,803 | 18.51 | 0.92 | 91.65 | 1,477 | 73.10 |
| Lodging | 113,929 | 9.78 | 0.38 | 38.14 | 1,115 | 43.50 |
| Miscellaneous | 461,474 | 9.14 | 0.24 | 24.11 | 4,219 | 111.30 |
| All Offices | 426,330 | 15.8 | 0.22 | 22.19 | 6,736 | 94.60 |
| All Warehouses | 217,497 | 8.68 | 0.05 | 4.77 | 1,889 | 10.40 |

Figure 9-1: Electricity Use by Building Type

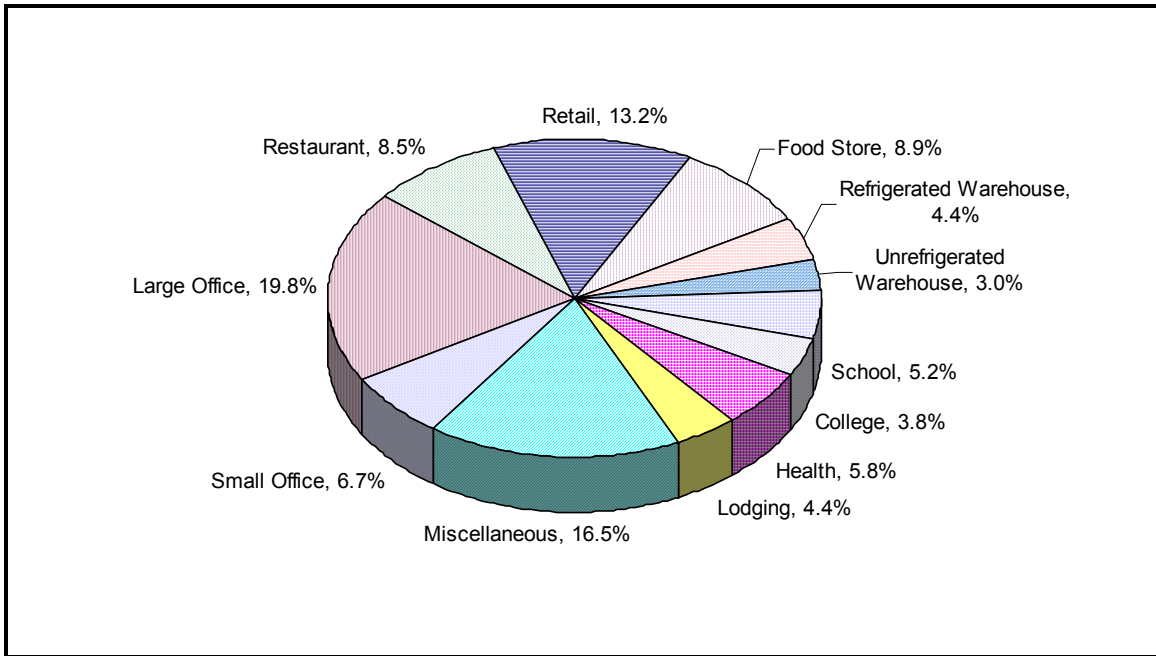


Figure 9-2: Natural Gas Usage by Building Type

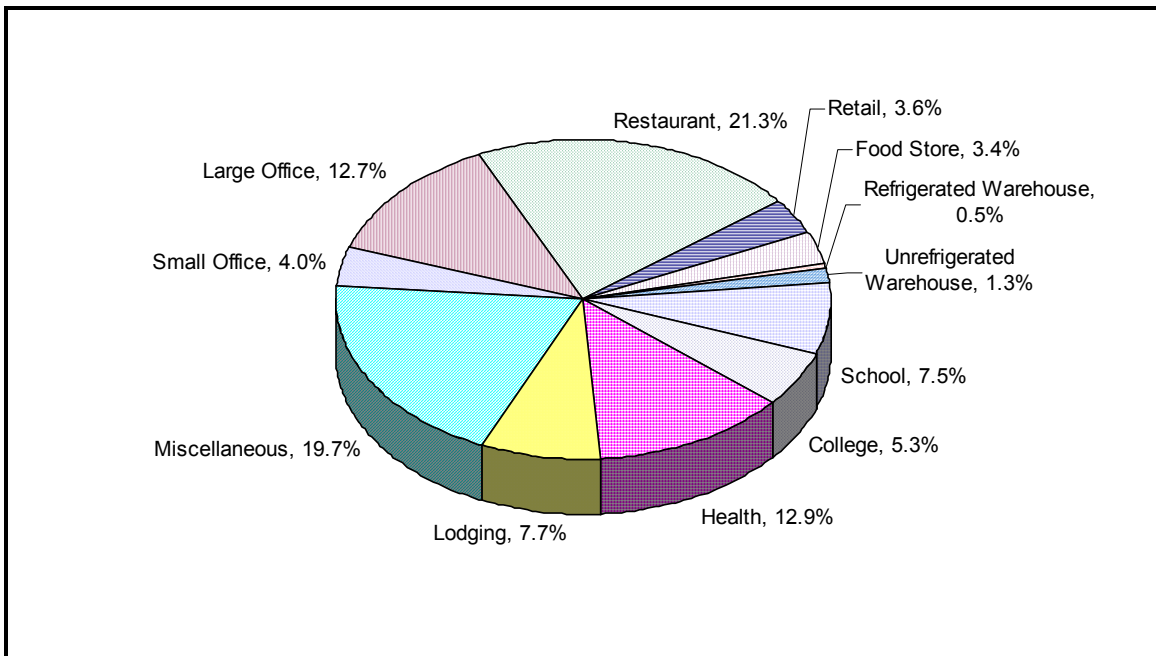


Figure 9-3: Electric Usage by End Use

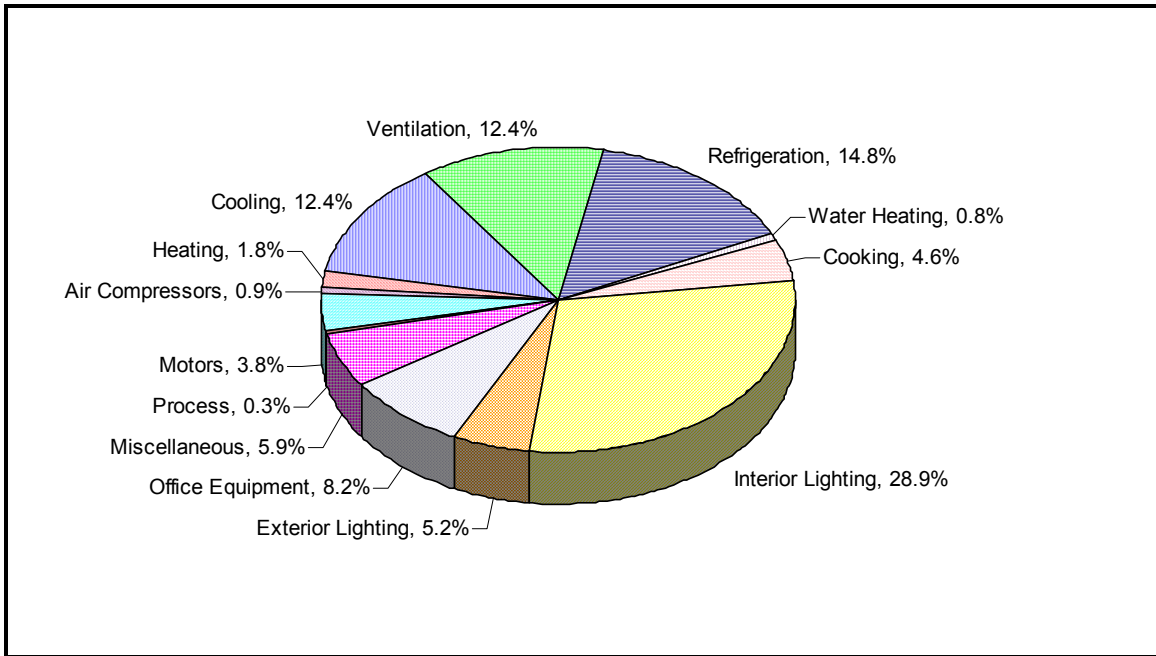
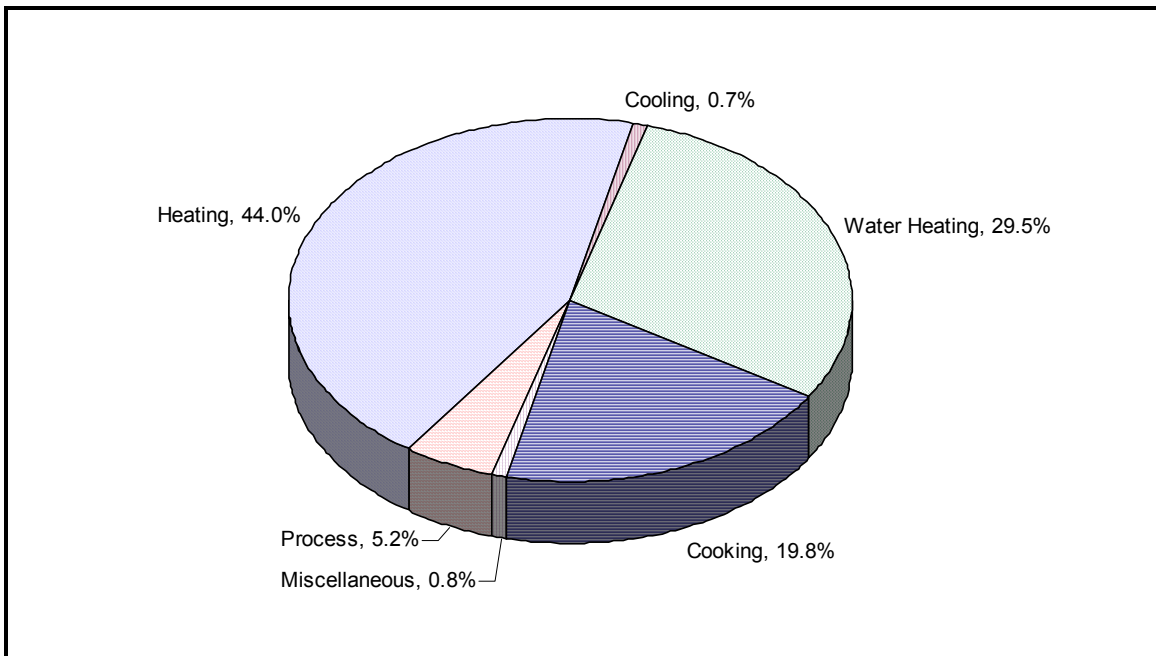


Figure 9-4: Natural Gas Usage by End Use



California Commercial End-Use Survey

Table 9-2: 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 | 447.20 | 3,151.00 | 3,174.80 | 3,782.30 | 210.80 | 1,168.40 | 7,365.60 | 1,338.40 | 2,082.80 | 1,512.50 | 64.60 | 979.10 | 228.70 | 25,506.30 |
| Small Office | 30.40 | 311.20 | 179.40 | 62.10 | 25.20 | 7.10 | 478.50 | 91.20 | 360.40 | 124.10 | 0.70 | 15.40 | 11.60 | 1,697.30 |
| Large Office | 155.50 | 932.50 | 894.30 | 104.10 | 34.00 | 37.20 | 1,273.00 | 96.90 | 1,116.50 | 152.30 | 0.40 | 216.50 | 25.40 | 5,038.70 |
| Restaurant | 1.10 | 231.20 | 135.00 | 596.40 | 19.60 | 617.20 | 374.20 | 95.20 | 34.80 | 49.80 | 0.80 | 13.90 | 1.10 | 2,170.20 |
| Retail | 30.50 | 433.50 | 447.60 | 266.70 | 31.30 | 56.80 | 1,467.70 | 170.60 | 136.10 | 213.90 | 7.20 | 74.60 | 20.20 | 3,356.80 |
| Food Store | 1.40 | 121.70 | 134.30 | 1,283.30 | 7.70 | 123.20 | 451.80 | 48.30 | 20.20 | 61.00 | 0.00 | 5.80 | 3.10 | 2,261.80 |
| Refrigerated Warehouse | 1.30 | 14.00 | 14.90 | 759.60 | 1.50 | 2.00 | 151.60 | 21.80 | 10.90 | 30.70 | 4.10 | 95.80 | 17.20 | 1,125.60 |
| Unrefrigerated Warehouse | 4.10 | 40.10 | 28.50 | 44.20 | 6.60 | 3.00 | 391.60 | 62.10 | 37.50 | 62.80 | 0.70 | 70.00 | 12.00 | 763.30 |
| School | 21.60 | 161.20 | 178.60 | 93.70 | 10.90 | 41.80 | 528.00 | 142.00 | 70.40 | 50.10 | 0.70 | 18.40 | 1.40 | 1,318.70 |
| College | 39.10 | 112.70 | 233.00 | 40.50 | 12.60 | 27.00 | 305.90 | 62.30 | 39.90 | 49.70 | 0.00 | 32.70 | 7.30 | 962.70 |
| Health | 59.20 | 250.60 | 327.00 | 56.00 | 4.50 | 42.80 | 363.30 | 39.60 | 61.90 | 177.30 | 0.00 | 76.30 | 18.80 | 1,477.10 |
| Lodging | 53.60 | 173.50 | 172.70 | 87.10 | 5.30 | 69.00 | 326.60 | 63.40 | 13.70 | 101.40 | 0.00 | 45.40 | 2.90 | 1,114.70 |
| Miscellaneous | 49.30 | 368.80 | 429.60 | 388.50 | 51.60 | 141.50 | 1,253.30 | 445.00 | 180.50 | 439.40 | 49.90 | 314.40 | 107.60 | 4,219.30 |
| All Offices | 185.90 | 1,243.70 | 1,073.70 | 166.30 | 59.30 | 44.30 | 1,751.50 | 188.00 | 1,476.90 | 276.40 | 1.20 | 231.80 | 37.00 | 6,736.00 |
| All Warehouses | 5.50 | 54.10 | 43.40 | 803.80 | 8.20 | 4.90 | 543.20 | 83.90 | 48.50 | 93.60 | 4.80 | 165.90 | 29.20 | 1,888.90 |

California Commercial End-Use Survey

Table 9-3: Electric Energy Intensities (kWh/ft²-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 | 12.95 | 0.23 | 1.60 | 1.61 | 1.92 | 0.11 | 0.59 | 3.74 | 0.68 | 1.06 | 0.77 | 0.03 | 0.50 | 0.12 |
| Small Office | 13.49 | 0.24 | 2.47 | 1.43 | 0.49 | 0.20 | 0.06 | 3.80 | 0.72 | 2.86 | 0.99 | 0.01 | 0.12 | 0.09 |
| Large Office | 16.77 | 0.52 | 3.10 | 2.98 | 0.35 | 0.11 | 0.12 | 4.24 | 0.32 | 3.72 | 0.51 | 0.00 | 0.72 | 0.08 |
| Restaurant | 33.12 | 0.02 | 3.53 | 2.06 | 9.10 | 0.30 | 9.42 | 5.71 | 1.45 | 0.53 | 0.76 | 0.01 | 0.21 | 0.02 |
| Retail | 12.19 | 0.11 | 1.57 | 1.63 | 0.97 | 0.11 | 0.21 | 5.33 | 0.62 | 0.49 | 0.78 | 0.03 | 0.27 | 0.07 |
| Food Store | 40.54 | 0.03 | 2.18 | 2.41 | 23.00 | 0.14 | 2.21 | 8.10 | 0.87 | 0.36 | 1.09 | 0.00 | 0.10 | 0.06 |
| Refrigerated Warehouse | 18.50 | 0.02 | 0.23 | 0.25 | 12.48 | 0.03 | 0.03 | 2.49 | 0.36 | 0.18 | 0.50 | 0.07 | 1.58 | 0.28 |
| Unrefrigerated Warehouse | 4.87 | 0.03 | 0.26 | 0.18 | 0.28 | 0.04 | 0.02 | 2.50 | 0.40 | 0.24 | 0.40 | 0.00 | 0.45 | 0.08 |
| School | 6.82 | 0.11 | 0.83 | 0.92 | 0.48 | 0.06 | 0.22 | 2.73 | 0.73 | 0.36 | 0.26 | 0.00 | 0.10 | 0.01 |
| College | 11.94 | 0.48 | 1.40 | 2.89 | 0.50 | 0.16 | 0.33 | 3.79 | 0.77 | 0.49 | 0.62 | 0.00 | 0.41 | 0.09 |
| Health | 18.51 | 0.74 | 3.14 | 4.10 | 0.70 | 0.06 | 0.54 | 4.55 | 0.50 | 0.78 | 2.22 | 0.00 | 0.96 | 0.24 |
| Lodging | 9.78 | 0.47 | 1.52 | 1.52 | 0.76 | 0.05 | 0.61 | 2.87 | 0.56 | 0.12 | 0.89 | 0.00 | 0.40 | 0.03 |
| Miscellaneous | 9.14 | 0.11 | 0.80 | 0.93 | 0.84 | 0.11 | 0.31 | 2.72 | 0.96 | 0.39 | 0.95 | 0.11 | 0.68 | 0.23 |
| All Offices | 15.80 | 0.44 | 2.92 | 2.52 | 0.39 | 0.14 | 0.10 | 4.11 | 0.44 | 3.46 | 0.65 | 0.00 | 0.54 | 0.09 |
| All Warehouses | 8.68 | 0.03 | 0.25 | 0.20 | 3.70 | 0.04 | 0.02 | 2.50 | 0.39 | 0.22 | 0.43 | 0.02 | 0.76 | 0.13 |

Table 9-4: Natural Gas Usage (Mtherms) by Building Type and End Use

| Building Type | Heat | Cool | WH | Cook | Misc. | Proc. | Total |
|--------------------------|--------|------|--------|--------|-------|-------|--------|
| All Commercial | 248.50 | 4.00 | 166.70 | 111.80 | 4.70 | 29.10 | 564.80 |
| Small Office | 21.00 | 0.00 | 1.60 | 0.00 | 0.00 | 0.10 | 22.70 |
| Large Office | 61.60 | 0.00 | 7.70 | 0.40 | 0.00 | 2.30 | 71.90 |
| Restaurant | 5.00 | 0.00 | 26.40 | 88.70 | 0.00 | 0.20 | 120.30 |
| Retail | 15.00 | 0.00 | 2.80 | 0.70 | 1.70 | 0.00 | 20.10 |
| Food Store | 8.10 | 0.00 | 5.80 | 5.30 | 0.00 | 0.00 | 19.20 |
| Refrigerated Warehouse | 0.50 | 0.00 | 0.40 | 1.20 | 0.00 | 0.70 | 2.70 |
| Unrefrigerated Warehouse | 6.30 | 0.00 | 1.10 | 0.00 | 0.10 | 0.10 | 7.60 |
| School | 28.80 | 0.60 | 10.20 | 2.60 | 0.00 | 0.00 | 42.10 |
| College | 21.90 | 0.00 | 7.20 | 1.00 | 0.00 | 0.00 | 30.20 |
| Health | 29.90 | 1.60 | 30.60 | 2.30 | 0.40 | 8.30 | 73.10 |
| Lodging | 5.30 | 0.20 | 31.10 | 5.10 | 1.40 | 0.30 | 43.50 |
| Miscellaneous | 45.20 | 1.60 | 41.80 | 4.50 | 1.10 | 17.00 | 111.30 |
| All Offices | 82.50 | 0.00 | 9.30 | 0.40 | 0.00 | 2.40 | 94.60 |
| All Warehouses | 6.80 | 0.00 | 1.50 | 1.20 | 0.10 | 0.80 | 10.40 |

Table 9-5: Natural Gas Usage Intensities (kBtu/ft²-yr) by Building Type and End Use

| Building Type | Total | Heat | Cool | WH | Cook | Misc. | Proc. |
|--------------------------|--------|-------|------|-------|--------|-------|-------|
| All Commercial | 28.67 | 12.60 | 0.20 | 8.50 | 5.70 | 0.20 | 1.50 |
| Small Office | 18.02 | 16.70 | 0.00 | 1.20 | 0.00 | 0.00 | 0.10 |
| Large Office | 23.94 | 20.50 | 0.00 | 2.60 | 0.10 | 0.00 | 0.80 |
| Restaurant | 183.53 | 7.70 | 0.00 | 40.30 | 135.30 | 0.00 | 0.30 |
| Retail | 7.31 | 5.40 | 0.00 | 1.00 | 0.20 | 0.60 | 0.00 |
| Food Store | 34.46 | 14.50 | 0.00 | 10.40 | 9.50 | 0.00 | 0.00 |
| Refrigerated Warehouse | 4.5 | 0.90 | 0.00 | 0.60 | 1.90 | 0.00 | 1.10 |
| Unrefrigerated Warehouse | 4.88 | 4.00 | 0.00 | 0.70 | 0.00 | 0.10 | 0.10 |
| School | 21.75 | 14.90 | 0.30 | 5.30 | 1.30 | 0.00 | 0.00 |
| College | 37.46 | 27.20 | 0.00 | 8.90 | 1.30 | 0.00 | 0.00 |
| Health | 91.65 | 37.40 | 2.00 | 38.40 | 2.90 | 0.50 | 10.40 |
| Lodging | 38.14 | 4.60 | 0.20 | 27.30 | 4.50 | 1.20 | 0.30 |
| Miscellaneous | 24.11 | 9.80 | 0.40 | 9.10 | 1.00 | 0.20 | 3.70 |
| All Offices | 22.19 | 19.40 | 0.00 | 2.20 | 0.10 | 0.00 | 0.60 |
| All Warehouses | 4.77 | 3.10 | 0.00 | 0.70 | 0.50 | 0.00 | 0.40 |

9.3 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 in the PG&E service area is 1,969,884 kft². Electric and natural gas EUIs, fuel shares and energy intensities for the overall PG&E commercial sector are presented in Table 9-6 and Table 9-7.

Table 9-6: 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 | 0.56 | 40.70 | 0.23 |
| Cooling | 2.31 | 69.30 | 1.60 |
| Ventilation | 2.02 | 79.80 | 1.61 |
| Water Heating | 0.26 | 41.60 | 0.11 |
| Cooking | 0.67 | 88.70 | 0.59 |
| Refrigeration | 2.10 | 91.30 | 1.92 |
| Interior Lighting | 3.75 | 99.70 | 3.74 |
| Office Equipment | 1.09 | 97.30 | 1.06 |
| Exterior Lighting | 0.75 | 91.00 | 0.68 |
| Miscellaneous | 0.84 | 91.00 | 0.77 |
| Process | 1.46 | 2.30 | 0.03 |
| Motors | 0.87 | 57.20 | 0.50 |
| Air Compressors | 0.31 | 37.10 | 0.12 |
| All End Uses | - | - | 12.96 |

Table 9-7: 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 | 24.65 | 67.60 | 16.66 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 3.61 | 34.50 | 1.25 |
| Cooking | 2.19 | 0.30 | 0.01 |
| Miscellaneous | 12.65 | 0.20 | 0.02 |
| Process | 23.27 | 0.30 | 0.08 |
| All End Uses | - | - | 18.02 |

Small Offices

Estimated total floor stock in small office buildings (defined as premises with total floor area less than 30,000 square feet) is just over 125 million square feet. Based on the electric intensities shown in the last column of Table 9-8, the largest electric end uses in this building type are interior lighting, office equipment and cooling. As shown in Table 9-9, the predominant gas end use is space heating.

Table 9-8: 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 | 0.75 | 32.10 | 0.24 |
| Cooling | 2.87 | 86.10 | 2.47 |
| Ventilation | 1.61 | 88.70 | 1.43 |
| Water Heating | 0.31 | 65.30 | 0.20 |
| Cooking | 0.06 | 95.80 | 0.06 |
| Refrigeration | 0.53 | 94.00 | 0.49 |
| Interior Lighting | 3.80 | 100.00 | 3.80 |
| Office Equipment | 2.91 | 98.40 | 2.86 |
| Exterior Lighting | 0.88 | 82.30 | 0.72 |
| Miscellaneous | 1.21 | 81.60 | 0.99 |
| Process | 0.73 | 0.80 | 0.01 |
| Motors | 0.51 | 23.90 | 0.12 |
| Air Compressors | 0.41 | 22.30 | 0.09 |
| All End Uses | - | - | 13.48 |

Table 9-9: 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 | 24.65 | 67.60 | 16.66 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 3.61 | 34.50 | 1.25 |
| Cooking | 2.19 | 0.30 | 0.01 |
| Miscellaneous | 12.65 | 0.20 | 0.02 |
| Process | 23.27 | 0.30 | 0.08 |
| All End Uses | - | - | 18.02 |

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 300 million square feet. As shown in Table 9-10, the largest electric end uses in this building type are interior lighting, cooling, ventilation, and office equipment. Table 9-11 shows that space heating is the major gas end use.

Table 9-10: 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 | 0.67 | 77.20 | 0.52 |
| Cooling | 3.37 | 92.20 | 3.10 |
| Ventilation | 3.12 | 95.50 | 2.98 |
| Water Heating | 0.21 | 52.90 | 0.11 |
| Cooking | 0.13 | 98.70 | 0.12 |
| Refrigeration | 0.35 | 98.00 | 0.35 |
| Interior Lighting | 4.24 | 100.00 | 4.24 |
| Office Equipment | 3.72 | 100.00 | 3.72 |
| Exterior Lighting | 0.35 | 92.70 | 0.32 |
| Miscellaneous | 0.54 | 93.00 | 0.51 |
| Process | 0.07 | 1.90 | 0.00 |
| Motors | 0.80 | 90.10 | 0.72 |
| Air Compressors | 0.12 | 70.80 | 0.08 |
| All End Uses | | | 16.77 |

Table 9-11: 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 | 26.30 | 77.90 | 20.48 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 4.35 | 58.90 | 2.56 |
| Cooking | 1.03 | 12.40 | 0.13 |
| Miscellaneous | 0.13 | 1.10 | 0.00 |
| Process | 534.09 | 0.10 | 0.77 |
| All End Uses | | | 23.94 |

Restaurants

Estimated total floor stock for this building type is just over 65 million square feet. Table 9-12 shows that cooking, refrigeration, and interior lighting are the largest electric end uses in this building type. Table 9-13 shows that the most important natural gas end uses are cooking and water heating.

Table 9-12: 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 | 0.18 | 8.70 | 0.02 |
| Cooling | 5.72 | 61.70 | 3.53 |
| Ventilation | 2.74 | 75.20 | 2.06 |
| Water Heating | 2.14 | 14.00 | 0.30 |
| Cooking | 9.42 | 100.00 | 9.42 |
| Refrigeration | 9.10 | 100.00 | 9.10 |
| Interior Lighting | 5.71 | 100.00 | 5.71 |
| Office Equipment | 0.54 | 98.10 | 0.53 |
| Exterior Lighting | 1.65 | 87.80 | 1.45 |
| Miscellaneous | 0.96 | 79.20 | 0.76 |
| Process | 1.21 | 1.10 | 0.01 |
| Motors | 1.51 | 14.10 | 0.21 |
| Air Compressors | 0.55 | 3.00 | 0.02 |
| All End Uses | | | 33.12 |

Table 9-13: 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 | 12.61 | 61.10 | 7.70 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 44.29 | 91.00 | 40.29 |
| Cooking | 161.38 | 83.80 | 135.28 |
| Miscellaneous | 1.26 | 0.50 | 0.01 |
| Process | 24.14 | 1.10 | 0.26 |
| All End Uses | | | 183.53 |

Retail

Estimated total floor stock for this building type is just over 275 million square feet. As shown in Table 9-14, the predominant electric end use in this building type is interior lighting, although cooling and ventilation account for a substantial portion of usage. Table 9-15 shows that space heating accounts for most of natural gas consumption in the retail sector.

Table 9-14: 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 | 0.70 | 15.80 | 0.11 |
| Cooling | 2.03 | 77.70 | 1.57 |
| Ventilation | 1.93 | 84.30 | 1.63 |
| Water Heating | 0.22 | 52.50 | 0.11 |
| Cooking | 0.25 | 81.70 | 0.21 |
| Refrigeration | 1.15 | 84.30 | 0.97 |
| Interior Lighting | 5.33 | 100.00 | 5.33 |
| Office Equipment | 0.49 | 100.00 | 0.49 |
| Exterior Lighting | 0.75 | 82.70 | 0.62 |
| Miscellaneous | 0.89 | 87.20 | 0.78 |
| Process | 2.94 | 0.90 | 0.03 |
| Motors | 0.70 | 38.50 | 0.27 |
| Air Compressors | 0.32 | 22.80 | 0.07 |
| All End Uses | | | 12.19 |

Table 9-15: 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 | 9.22 | 59.00 | 5.44 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 2.82 | 35.60 | 1.00 |
| Cooking | 7.07 | 3.50 | 0.24 |
| Miscellaneous | 48.86 | 1.30 | 0.62 |
| Process | 0.00 | 0.00 | 0.00 |
| All End Uses | | | 7.30 |

Food Stores

Estimated total floor stock for this building type is approximately 56 million square feet. According to Table 9-16, the largest electric end use in this building type is refrigeration, with interior lighting comprising about half of remaining usage. Space heating, water heating and cooking all account for significant shares of gas consumption, as seen in Table 9-17.

Table 9-16: 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 | 0.21 | 12.10 | 0.03 |
| Cooling | 3.14 | 69.50 | 2.18 |
| Ventilation | 3.12 | 77.20 | 2.41 |
| Water Heating | 0.93 | 14.80 | 0.14 |
| Cooking | 2.67 | 82.70 | 2.21 |
| Refrigeration | 23.00 | 100.00 | 23.00 |
| Interior Lighting | 8.10 | 100.00 | 8.10 |
| Office Equipment | 0.37 | 99.10 | 0.36 |
| Exterior Lighting | 0.88 | 98.10 | 0.87 |
| Miscellaneous | 1.16 | 93.80 | 1.09 |
| Process | 0.00 | 0.00 | 0.00 |
| Motors | 0.53 | 19.50 | 0.10 |
| Air Compressors | 0.45 | 12.50 | 0.06 |
| All End Uses | | | 40.55 |

Table 9-17: 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 | 21.51 | 67.40 | 14.50 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 12.76 | 81.80 | 10.44 |
| Cooking | 19.40 | 49.10 | 9.52 |
| Miscellaneous | 0.00 | 0.00 | 0.00 |
| Process | 0.00 | 0.00 | 0.00 |
| All End Uses | | | 34.46 |

Refrigerated Warehouses

Estimated total floor stock for this building type is approximately 61 million square feet. Table 9-18 shows that refrigeration is the largest electric end use in this building type, accounting for roughly two-thirds of total electric usage. As seen in Table 9-19, the largest gas end use is cooking, although the overall gas intensity is low.

Table 9-18: 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 | 0.56 | 4.00 | 0.02 |
| Cooling | 2.38 | 9.70 | 0.23 |
| Ventilation | 2.35 | 10.40 | 0.25 |
| Water Heating | 0.04 | 63.80 | 0.03 |
| Cooking | 0.04 | 80.50 | 0.03 |
| Refrigeration | 12.48 | 100.00 | 12.48 |
| Interior Lighting | 2.49 | 100.00 | 2.49 |
| Office Equipment | 0.18 | 98.60 | 0.18 |
| Exterior Lighting | 0.36 | 100.00 | 0.36 |
| Miscellaneous | 0.52 | 96.70 | 0.50 |
| Process | 1.17 | 5.70 | 0.07 |
| Motors | 1.94 | 81.20 | 1.58 |
| Air Compressors | 0.33 | 85.90 | 0.28 |
| All End Uses | | | 18.50 |

Table 9-19: 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 | 14.06 | 6.10 | 0.85 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 2.00 | 30.70 | 0.61 |
| Cooking | 20.18 | 9.40 | 1.90 |
| Miscellaneous | 0.00 | 0.00 | 0.00 |
| Process | 9.39 | 12.10 | 1.14 |
| All End Uses | | | 4.50 |

Unrefrigerated Warehouses

Estimated total floor stock for this building type is almost 157 million square feet. Table 9-20 shows that the overall electric intensity in this building type is low, with interior lighting accounting for over half of electric usage. As seen in Table 9-21, the gas intensity is also low, with space heating being the predominant gas end.

Table 9-20: 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 | 0.31 | 8.60 | 0.03 |
| Cooling | 0.76 | 33.70 | 0.26 |
| Ventilation | 0.38 | 47.40 | 0.18 |
| Water Heating | 0.07 | 60.10 | 0.04 |
| Cooking | 0.02 | 91.00 | 0.02 |
| Refrigeration | 0.32 | 88.90 | 0.28 |
| Interior Lighting | 2.50 | 100.00 | 2.50 |
| Office Equipment | 0.25 | 97.10 | 0.24 |
| Exterior Lighting | 0.45 | 88.30 | 0.40 |
| Miscellaneous | 0.44 | 90.30 | 0.40 |
| Process | 0.29 | 1.60 | 0.00 |
| Motors | 0.74 | 60.50 | 0.45 |
| Air Compressors | 0.21 | 36.70 | 0.08 |
| All End Uses | | | 4.88 |

Table 9-21: 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 | 8.92 | 45.20 | 4.04 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 1.92 | 37.20 | 0.71 |
| Cooking | 0.00 | 0.00 | 0.00 |
| Miscellaneous | 1.12 | 5.40 | 0.06 |
| Process | 3.29 | 2.00 | 0.07 |
| All End Uses | | | 4.88 |

Schools

Estimated total floor stock for this building type is just over 193 million square feet. As shown in Table 9-22, the largest electric end uses in this building type are interior lighting, cooling, and ventilation. Table 9-23 shows that space heating is the major gas end use.

Table 9-22: 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 | 0.17 | 66.10 | 0.11 |
| Cooling | 1.15 | 72.80 | 0.83 |
| Ventilation | 0.94 | 97.90 | 0.92 |
| Water Heating | 0.16 | 35.50 | 0.06 |
| Cooking | 0.22 | 99.60 | 0.22 |
| Refrigeration | 0.49 | 99.60 | 0.48 |
| Interior Lighting | 2.73 | 100.00 | 2.73 |
| Office Equipment | 0.36 | 100.00 | 0.36 |
| Exterior Lighting | 0.77 | 95.80 | 0.73 |
| Miscellaneous | 0.28 | 92.60 | 0.26 |
| Process | 0.04 | 9.30 | 0.00 |
| Motors | 0.21 | 44.60 | 0.10 |
| Air Compressors | 0.06 | 12.40 | 0.01 |
| All End Uses | | | 6.81 |

Table 9-23: 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 | 15.89 | 93.60 | 14.87 |
| Cooling | 7.74 | 3.70 | 0.29 |
| Water Heating | 5.93 | 88.70 | 5.26 |
| Cooking | 2.18 | 60.70 | 1.32 |
| Miscellaneous | 0.28 | 4.50 | 0.01 |
| Process | 0.00 | 0.00 | 0.00 |
| All End Uses | | | 21.75 |

Colleges

Estimated total floor stock for this building type is approximately 81 million square feet. Table 9-24 shows that interior lighting, ventilation, and cooling are the largest electric end uses in this building type. As shown in Table 9-25, space heating accounts for most of the gas usage in this sector.

Table 9-24: 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 | 0.58 | 83.10 | 0.48 |
| Cooling | 1.92 | 72.70 | 1.40 |
| Ventilation | 3.13 | 92.40 | 2.89 |
| Water Heating | 0.50 | 31.40 | 0.16 |
| Cooking | 0.42 | 80.20 | 0.33 |
| Refrigeration | 0.67 | 75.30 | 0.50 |
| Interior Lighting | 3.79 | 100.00 | 3.79 |
| Office Equipment | 0.49 | 100.00 | 0.49 |
| Exterior Lighting | 0.83 | 93.60 | 0.77 |
| Miscellaneous | 0.62 | 99.40 | 0.62 |
| Process | 0.00 | 0.00 | 0.00 |
| Motors | 0.47 | 85.80 | 0.41 |
| Air Compressors | 0.19 | 48.20 | 0.09 |
| All End Uses | | | 11.93 |

Table 9-25: 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 | 30.02 | 90.50 | 27.17 |
| Cooling | 0.00 | 0.00 | 0.00 |
| Water Heating | 10.06 | 88.60 | 8.91 |
| Cooking | 4.91 | 26.20 | 1.29 |
| Miscellaneous | 0.77 | 5.50 | 0.04 |
| Process | 0.67 | 7.30 | 0.05 |
| All End Uses | | | 37.46 |

Health

Estimated total floor stock for this building type is approximately 80 million square feet. Table 9-26 shows that the largest electric end uses in this building type are interior lighting, ventilation and cooling. Heating and water heating account for the major shares of gas usage, as shown in Table 9-27.

Table 9-26: 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 | 0.94 | 79.30 | 0.74 |
| Cooling | 3.59 | 87.40 | 3.14 |
| Ventilation | 4.23 | 97.00 | 4.10 |
| Water Heating | 0.21 | 26.90 | 0.06 |
| Cooking | 0.54 | 100.00 | 0.54 |
| Refrigeration | 0.70 | 100.00 | 0.70 |
| Interior Lighting | 4.55 | 100.00 | 4.55 |
| Office Equipment | 0.78 | 100.00 | 0.78 |
| Exterior Lighting | 0.51 | 96.70 | 0.50 |
| Miscellaneous | 2.22 | 100.00 | 2.22 |
| Process | 0.00 | 0.00 | 0.00 |
| Motors | 1.19 | 80.50 | 0.96 |
| Air Compressors | 0.38 | 62.50 | 0.24 |
| All End Uses | | | 18.53 |

Table 9-27: 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 | 40.91 | 91.50 | 37.43 |
| Cooling | 104.34 | 2.00 | 2.05 |
| Water Heating | 42.31 | 90.70 | 38.39 |
| Cooking | 3.74 | 76.60 | 2.87 |
| Miscellaneous | 2.24 | 22.00 | 0.49 |
| Process | 32.05 | 32.50 | 10.42 |
| All End Uses | | | 91.65 |

Lodging

Estimated total floor stock for this building type is approximately 114 million square feet. According to Table 9-28, the biggest single end use in this sector is interior lighting, followed by cooling and ventilation. Table 9-29 shows that water heating accounts for most of the gas consumption.

Table 9-28: 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 | 0.52 | 89.90 | 0.47 |
| Cooling | 1.88 | 80.80 | 1.52 |
| Ventilation | 1.61 | 94.10 | 1.52 |
| Water Heating | 1.01 | 4.60 | 0.05 |
| Cooking | 0.65 | 92.80 | 0.61 |
| Refrigeration | 0.76 | 100.00 | 0.76 |
| Interior Lighting | 2.87 | 100.00 | 2.87 |
| Office Equipment | 0.13 | 93.40 | 0.12 |
| Exterior Lighting | 0.63 | 88.20 | 0.56 |
| Miscellaneous | 0.89 | 100.00 | 0.89 |
| Process | 0.00 | 0.00 | 0.00 |
| Motors | 0.43 | 91.80 | 0.40 |
| Air Compressors | 0.09 | 28.30 | 0.03 |
| All End Uses | | | 9.80 |

Table 9-29: 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 | 6.98 | 66.20 | 4.62 |
| Cooling | 17.32 | 0.90 | 0.16 |
| Water Heating | 31.98 | 85.40 | 27.32 |
| Cooking | 8.06 | 56.10 | 4.52 |
| Miscellaneous | 2.88 | 42.40 | 1.22 |
| Process | 3.53 | 8.50 | 0.30 |
| All End Uses | | | 38.14 |

Miscellaneous

Estimated total floor stock for this building type is approximately 461.5 million square feet. As shown in Table 9-30, the largest electric end use in this building type is interior lighting, with remaining electric usage spread out over several other end uses. Table 9-31 shows that space 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 9-30: 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 | 0.50 | 21.20 | 0.11 |
| Cooling | 1.38 | 57.70 | 0.80 |
| Ventilation | 1.34 | 69.50 | 0.93 |
| Water Heating | 0.32 | 35.30 | 0.11 |
| Cooking | 0.39 | 77.80 | 0.31 |
| Refrigeration | 1.01 | 83.60 | 0.84 |
| Interior Lighting | 2.75 | 98.90 | 2.72 |
| Office Equipment | 0.42 | 92.00 | 0.39 |
| Exterior Lighting | 1.03 | 93.90 | 0.96 |
| Miscellaneous | 1.07 | 89.40 | 0.95 |
| Process | 4.77 | 2.30 | 0.11 |
| Motors | 1.36 | 50.20 | 0.68 |
| Air Compressors | 0.66 | 35.50 | 0.23 |
| All End Uses | | | 9.14 |

Table 9-31: 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 | 18.92 | 51.80 | 9.80 |
| Cooling | 44.07 | 0.80 | 0.35 |
| Water Heating | 19.03 | 47.60 | 9.06 |
| Cooking | 4.03 | 24.50 | 0.99 |
| Miscellaneous | 3.52 | 6.60 | 0.23 |
| Process | 73.33 | 5.00 | 3.68 |
| All End Uses | | | 24.11 |

9.4 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\coldest¹ *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 9-5: All Commercial 16-Day Hourly End-Use Shapes

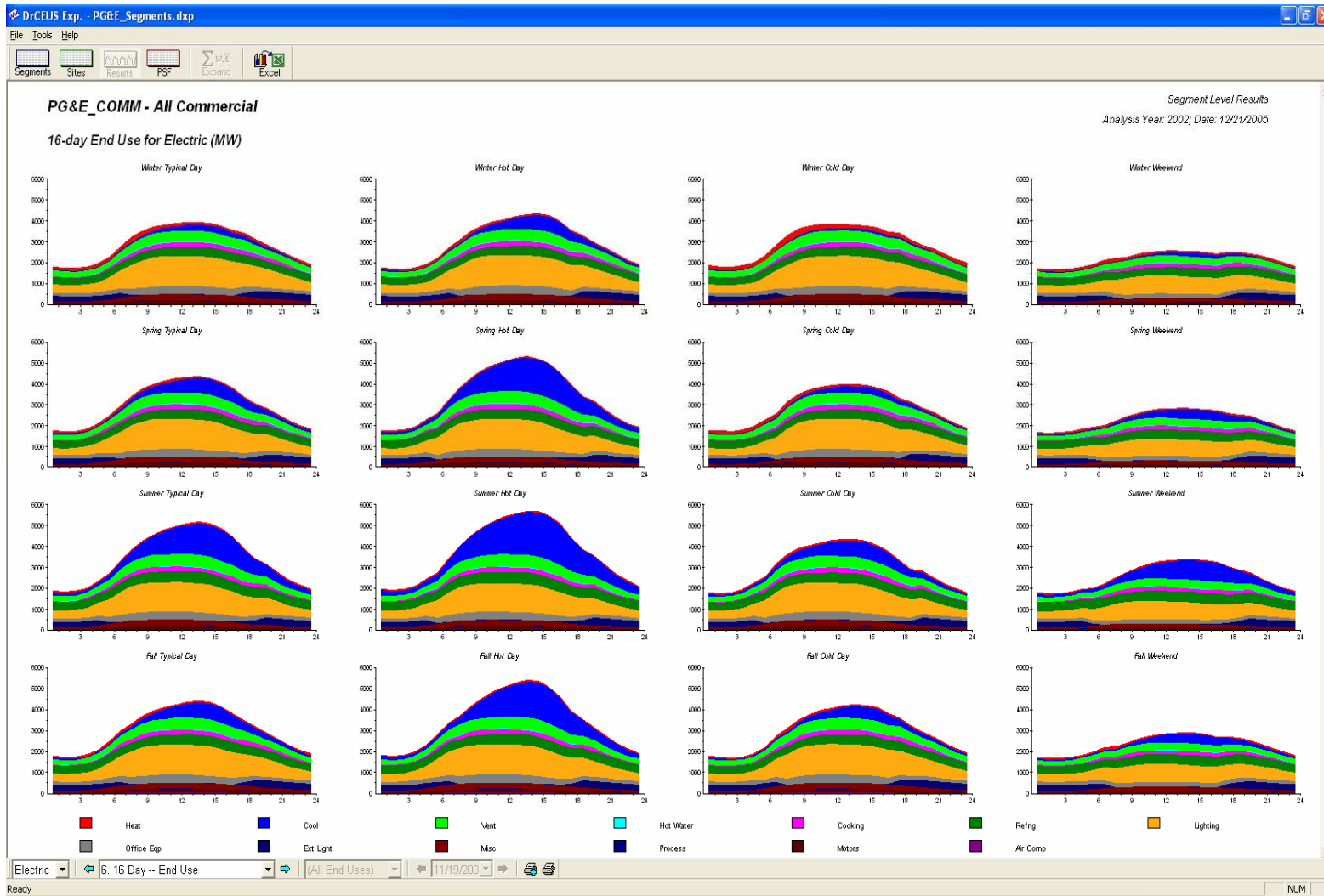


Figure 9-6: Small Office 16-Day Hourly End-Use Shapes

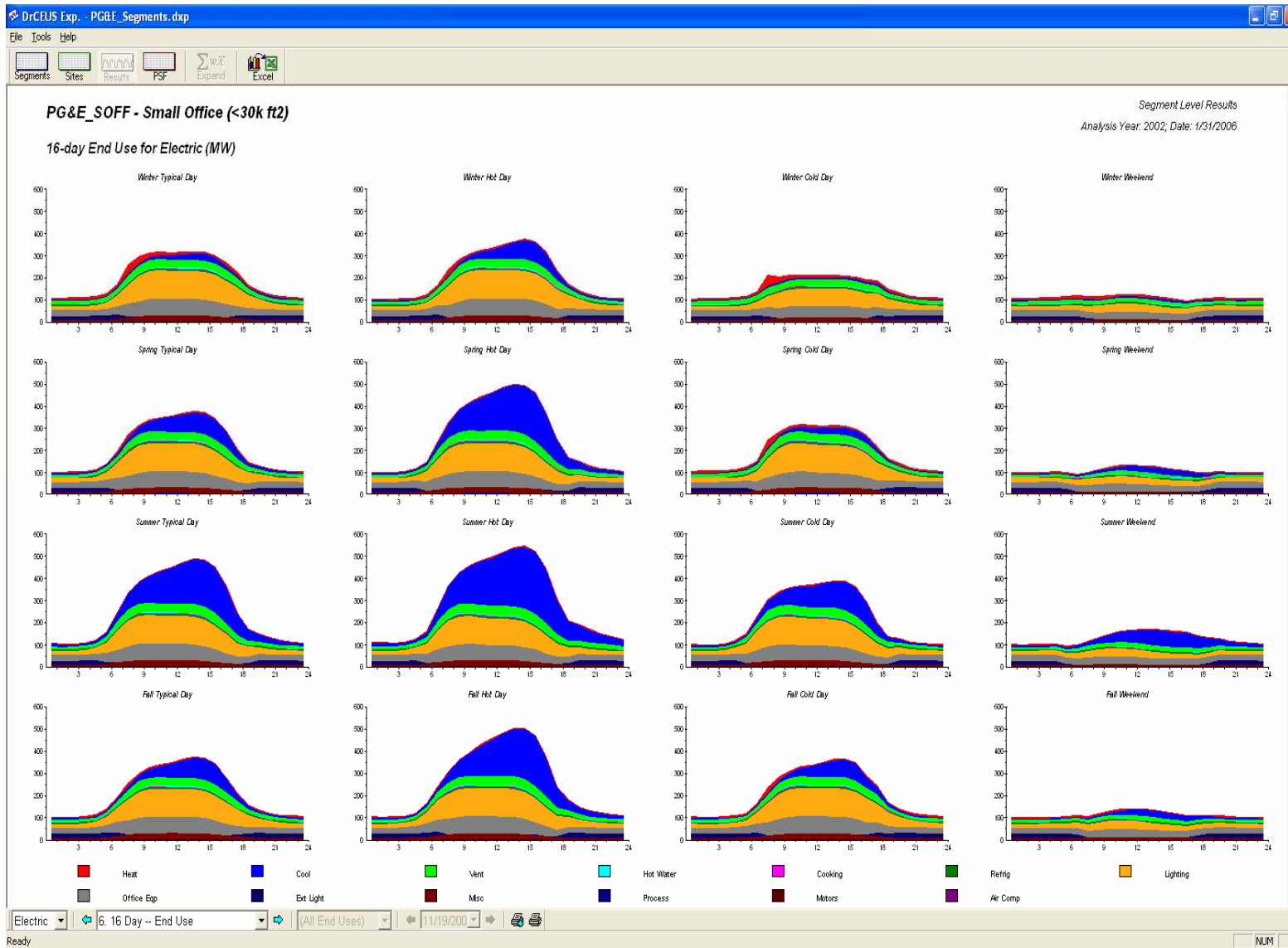


Figure 9-7: Large Office 16-Day Hourly End-Use Shapes

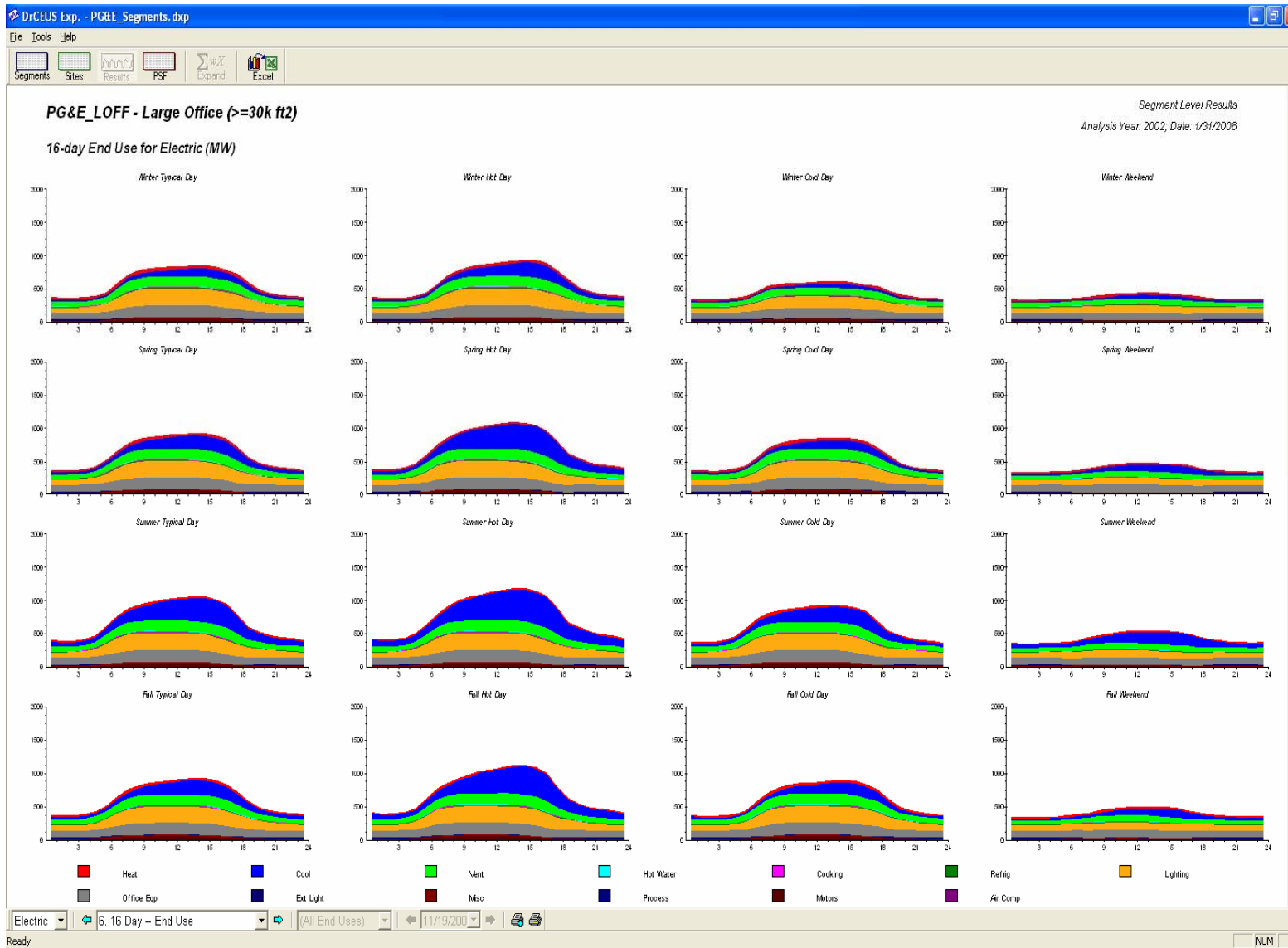


Figure 9-8: Restaurant 16-Day Hourly End-Use Shapes

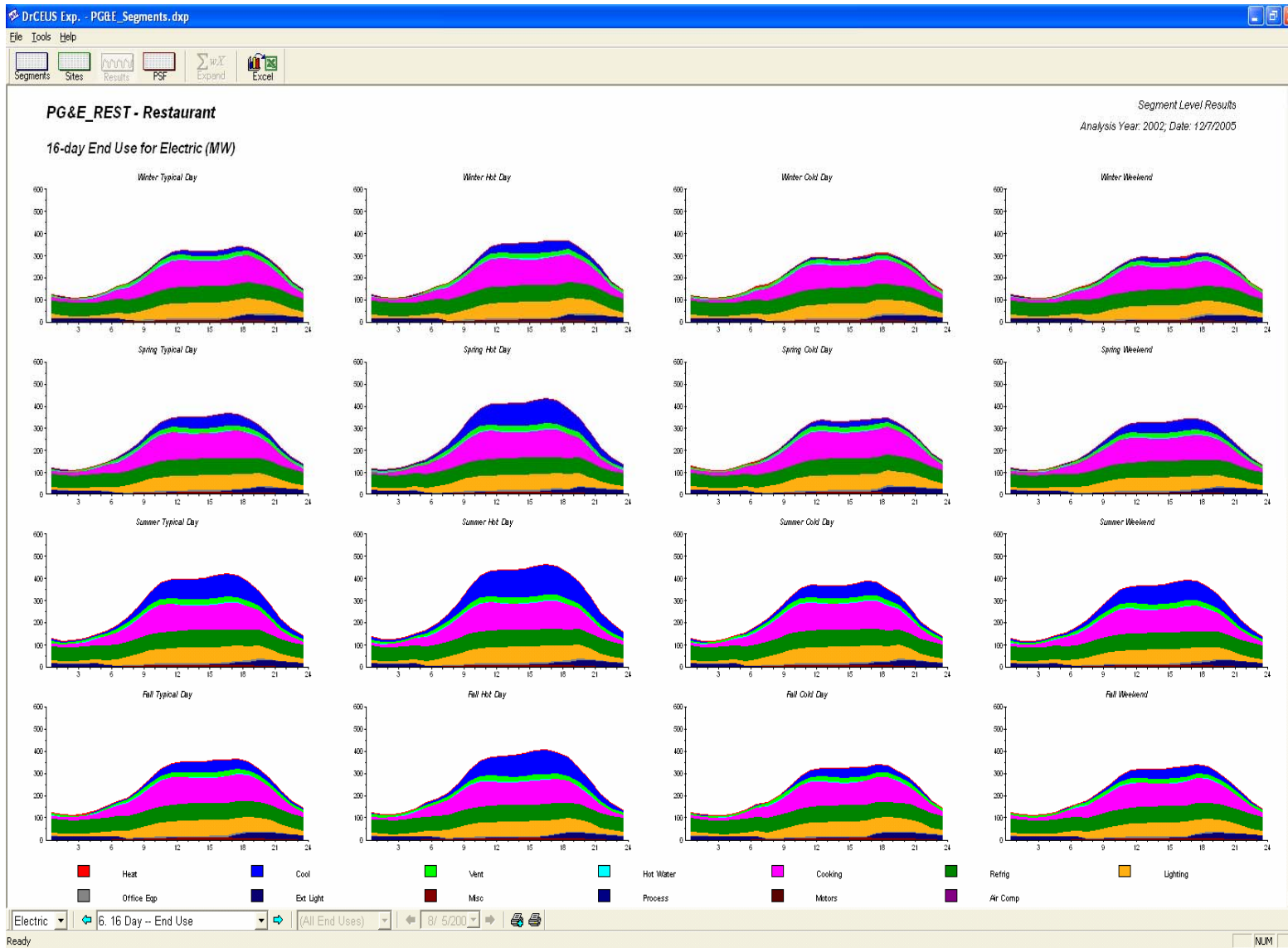


Figure 9-9: Retail 16-Day Hourly End-Use Shapes

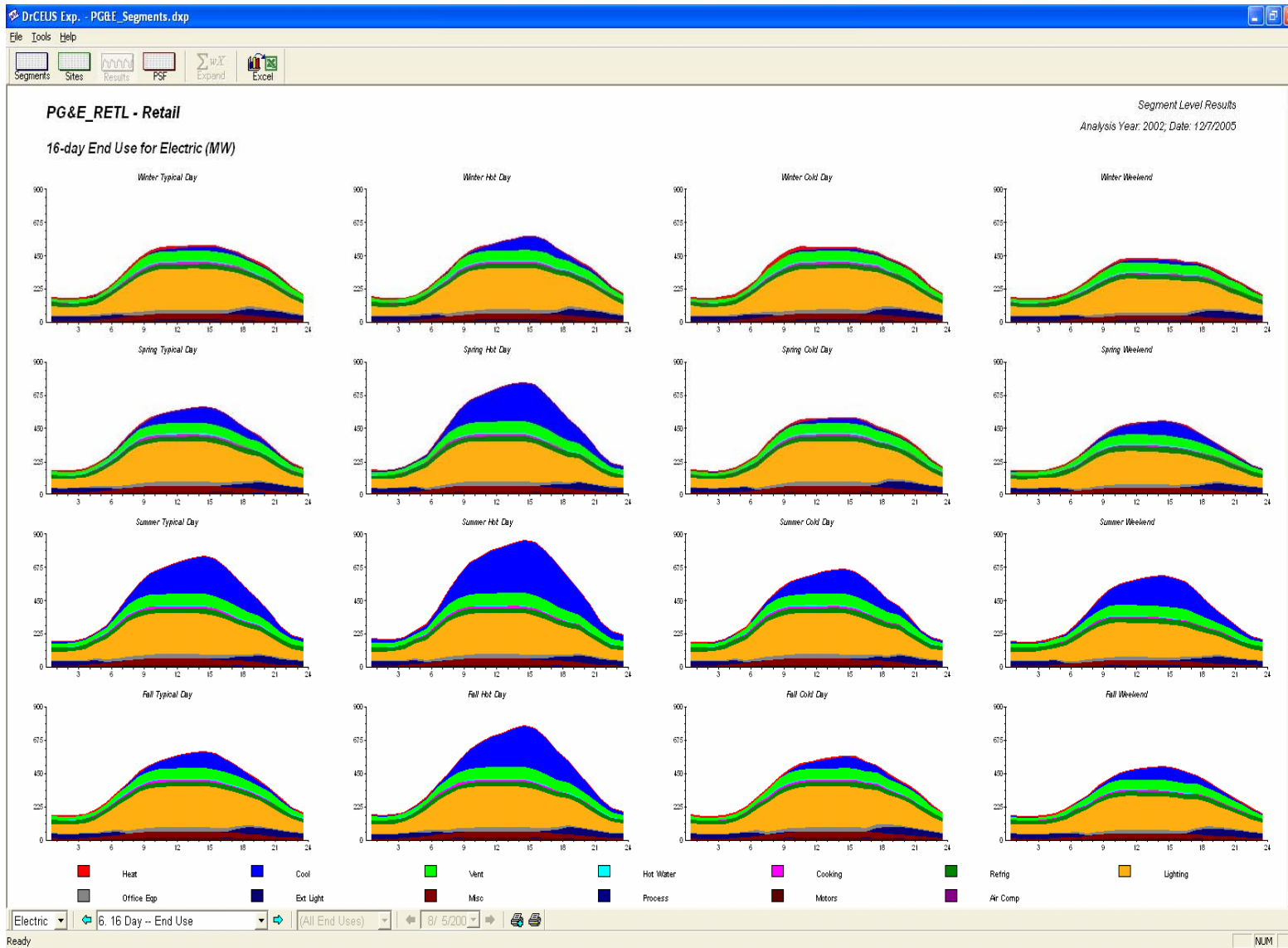


Figure 9-10: Food Store 16-Day Hourly End-Use Shapes

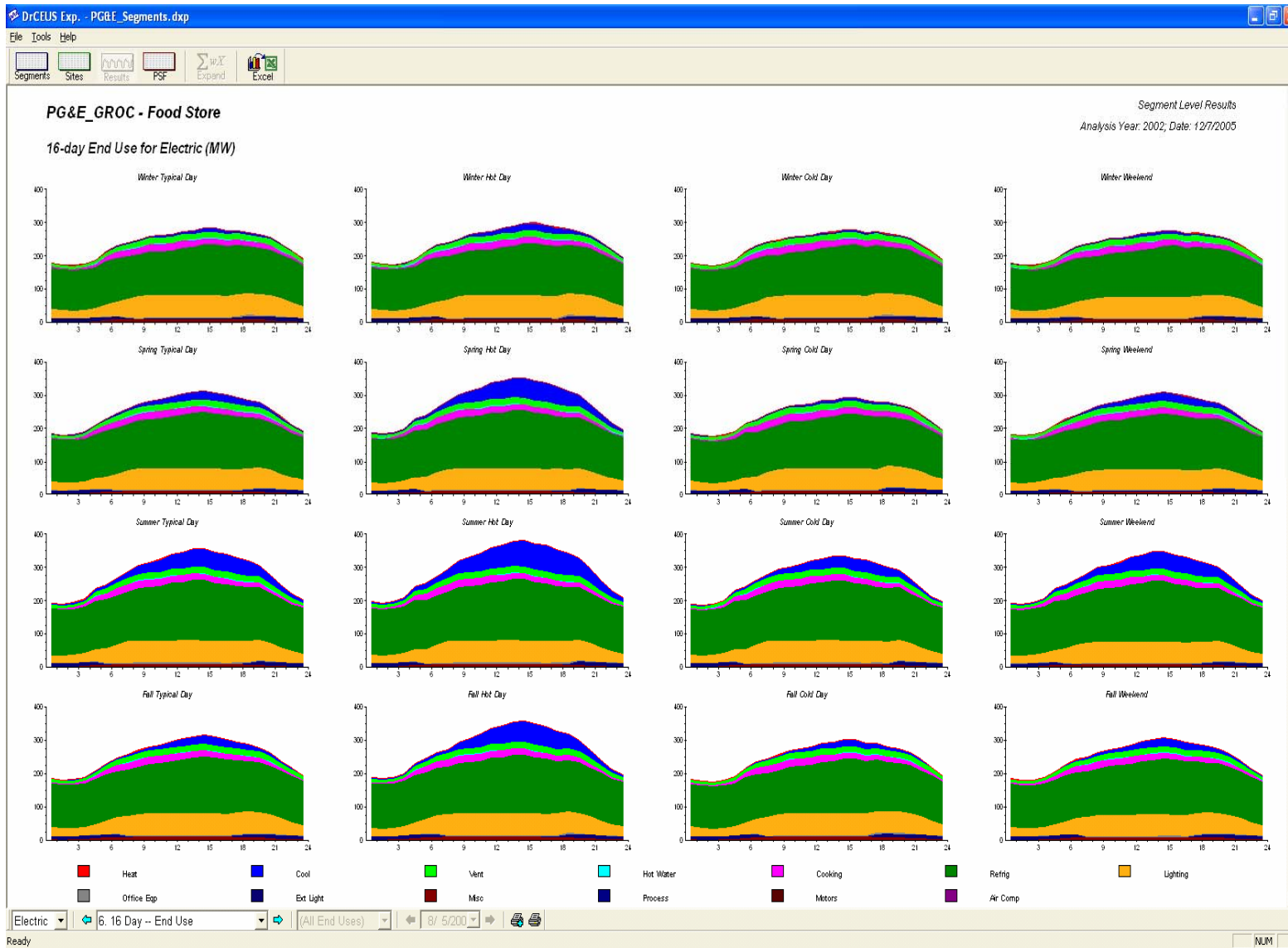


Figure 9-11: Refrigerated Warehouse 16-Day Hourly End-Use Shapes

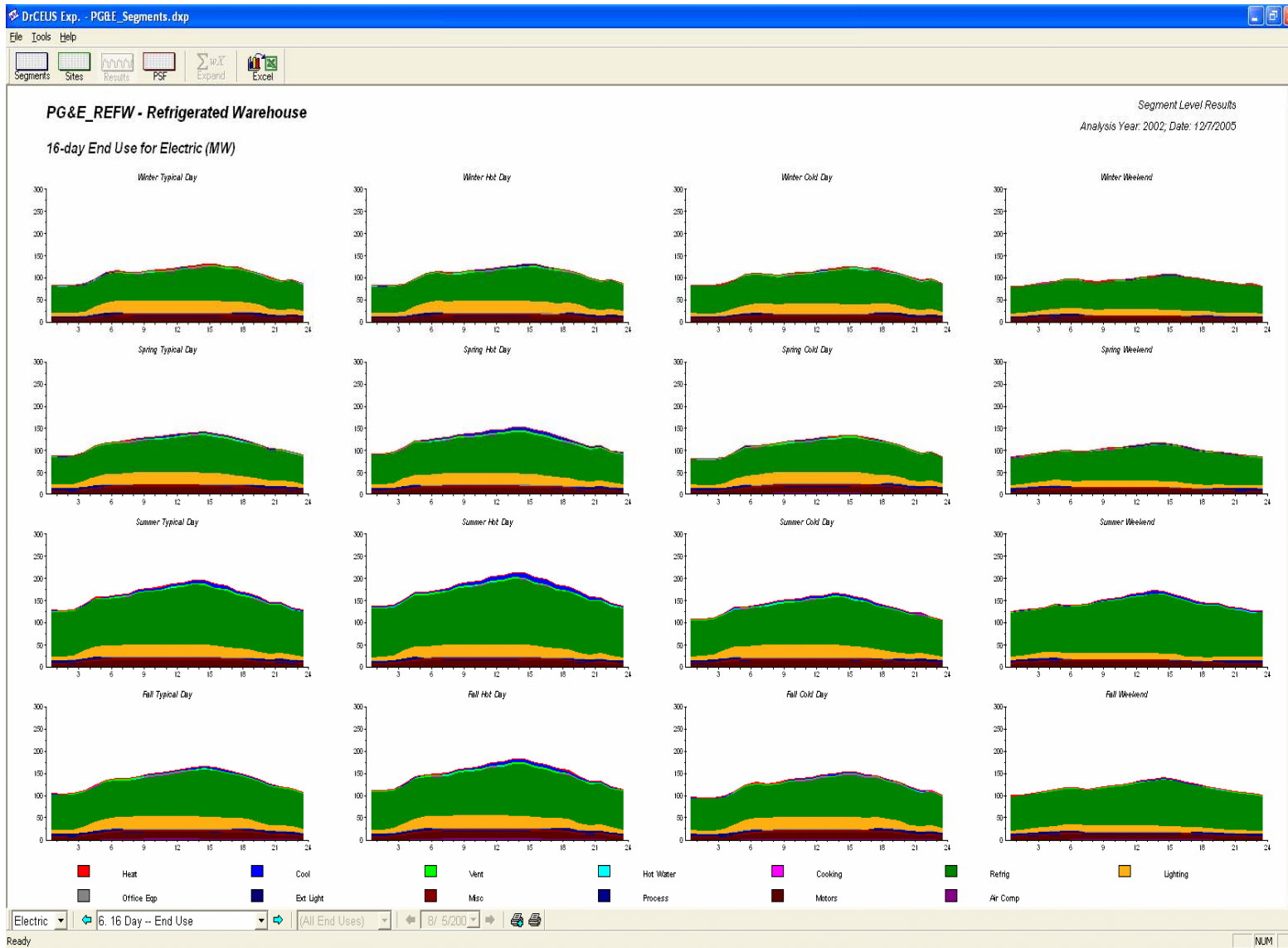


Figure 9-12: Unrefrigerated Warehouse 16-Day Hourly End-Use Shapes

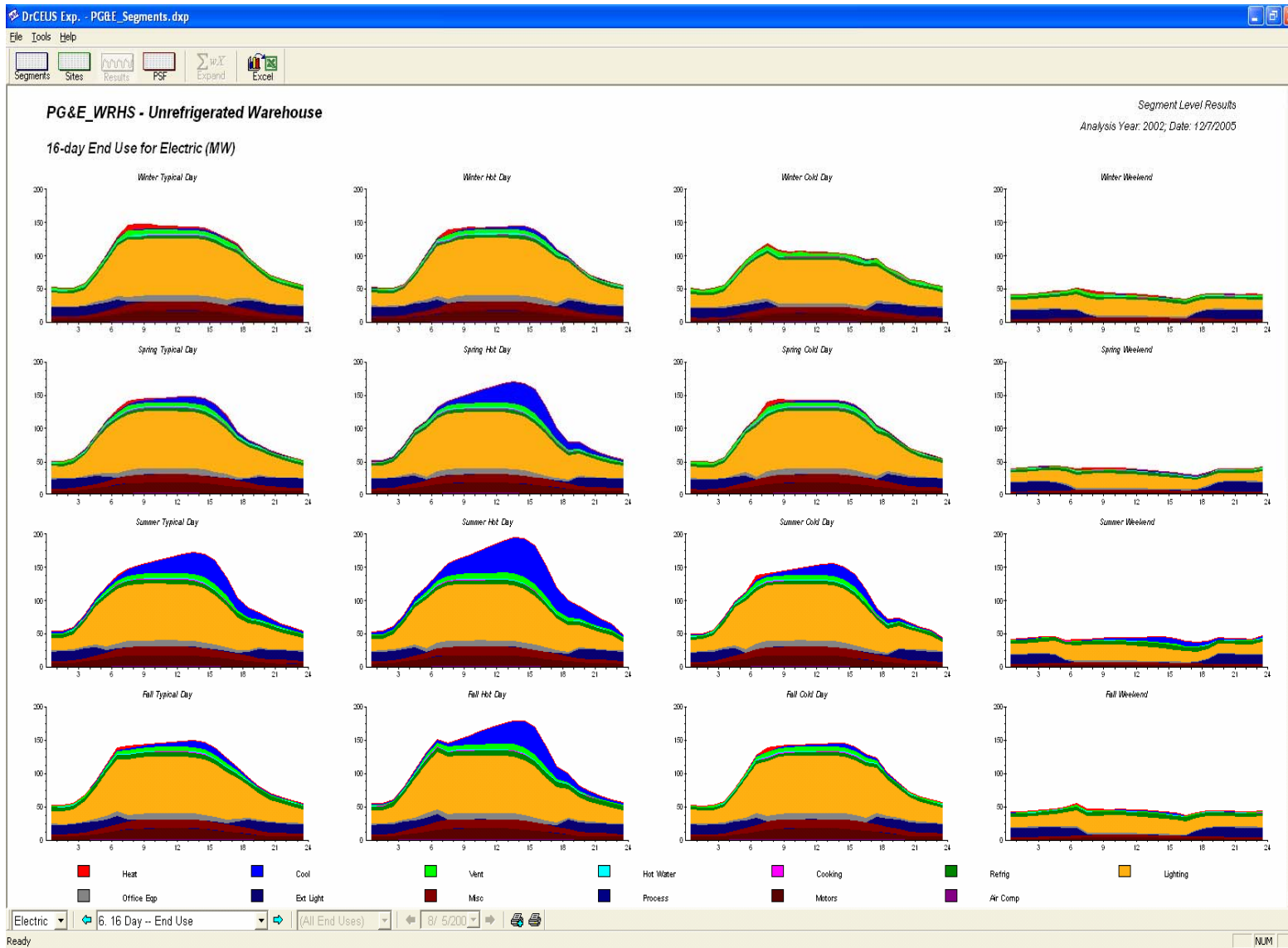


Figure 9-13: School 16-Day Hourly End-Use Shapes

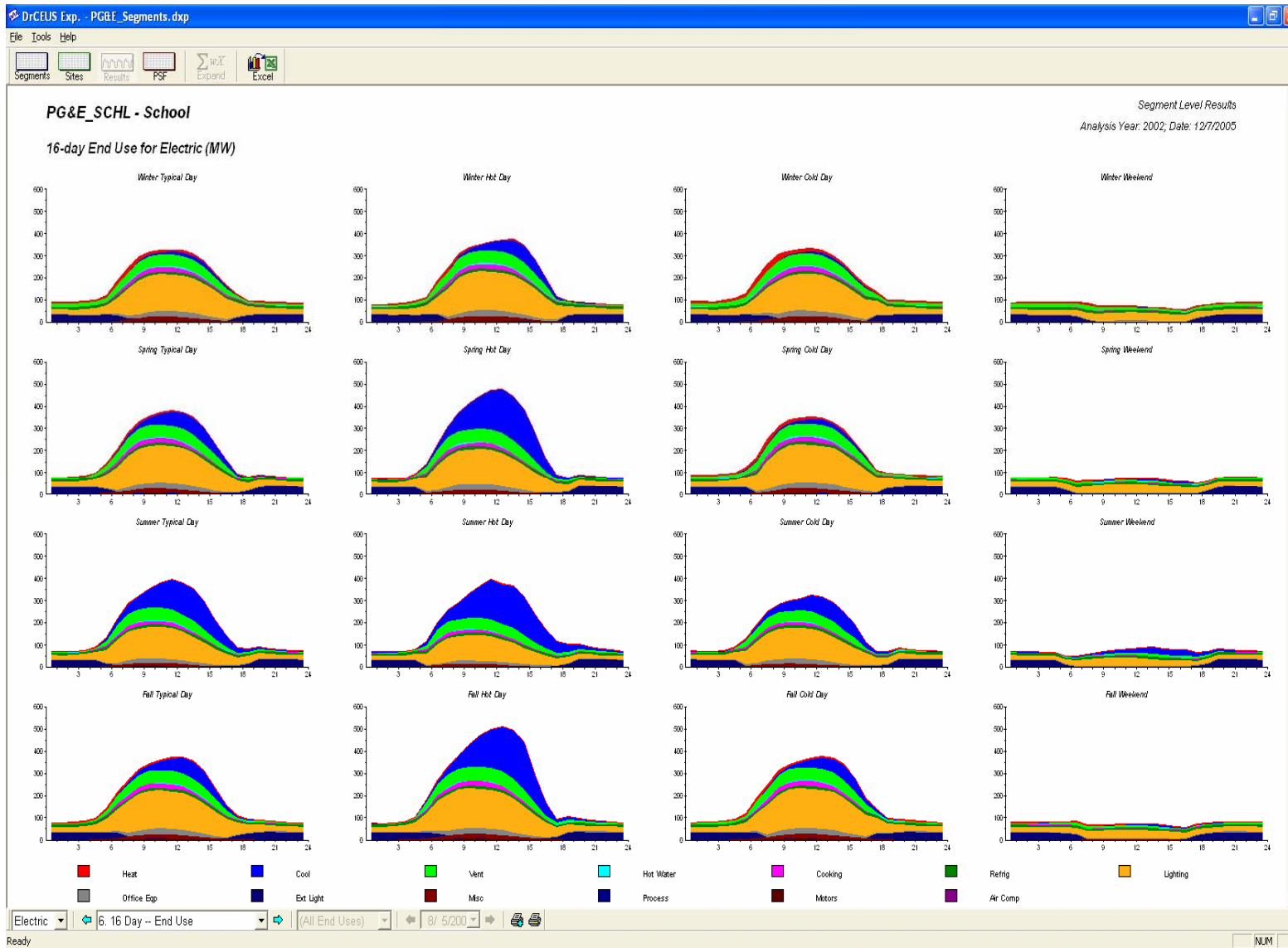


Figure 9-14: College 16-Day Hourly End-Use Shapes

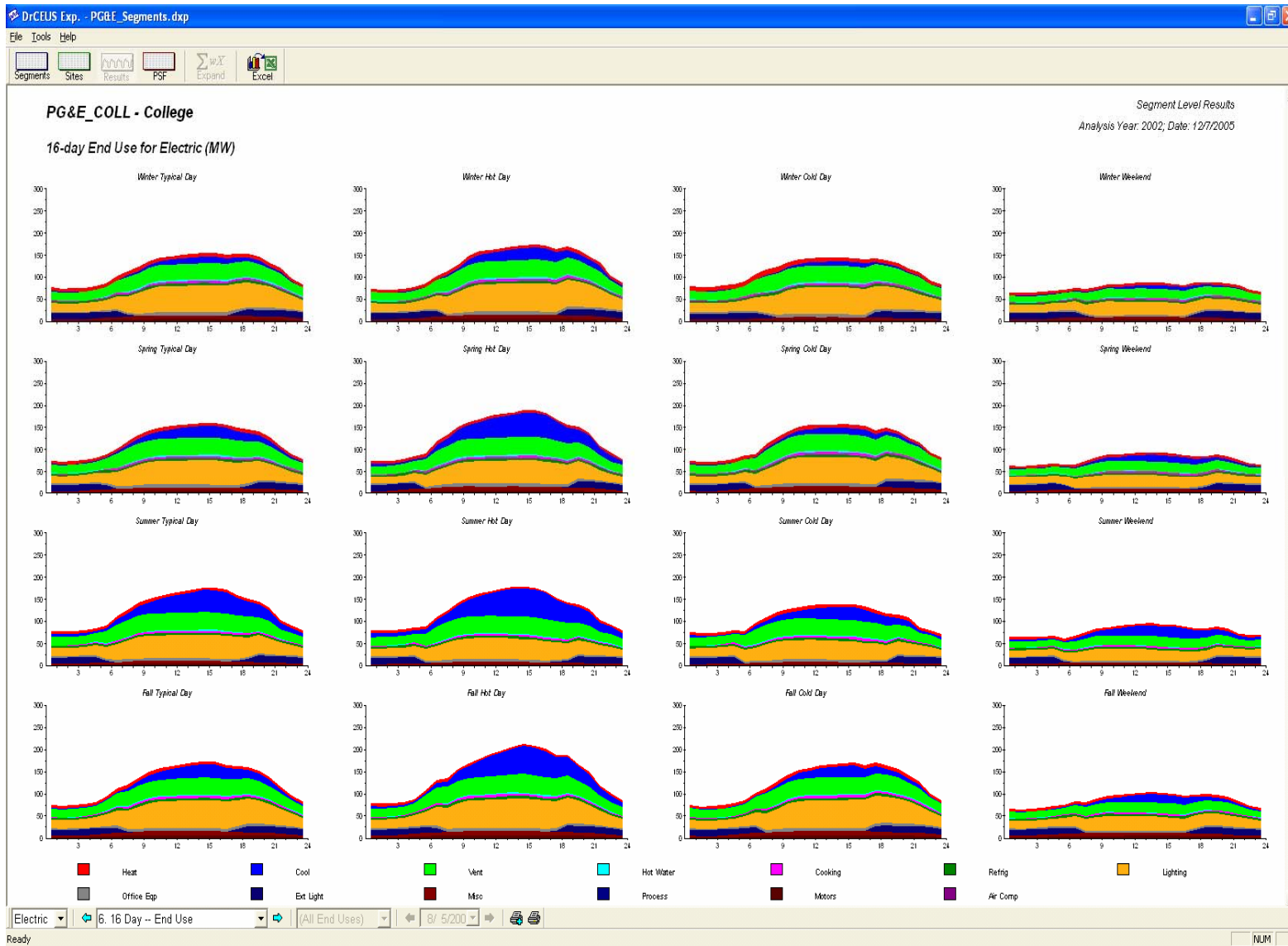


Figure 9-15: Health 16-Day Hourly End-Use Shapes

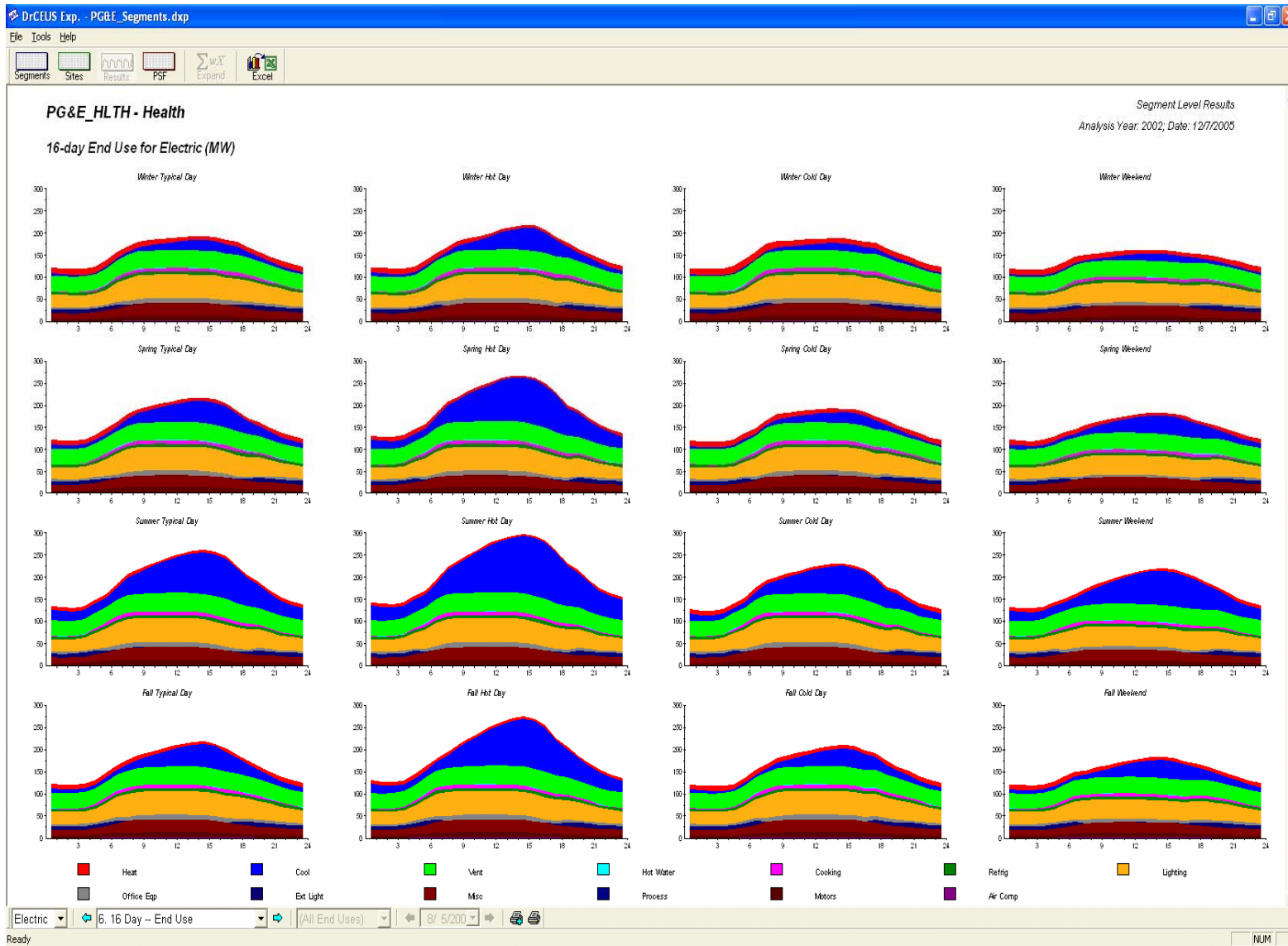


Figure 9-16: Lodging 16-Day Hourly End-Use Shapes

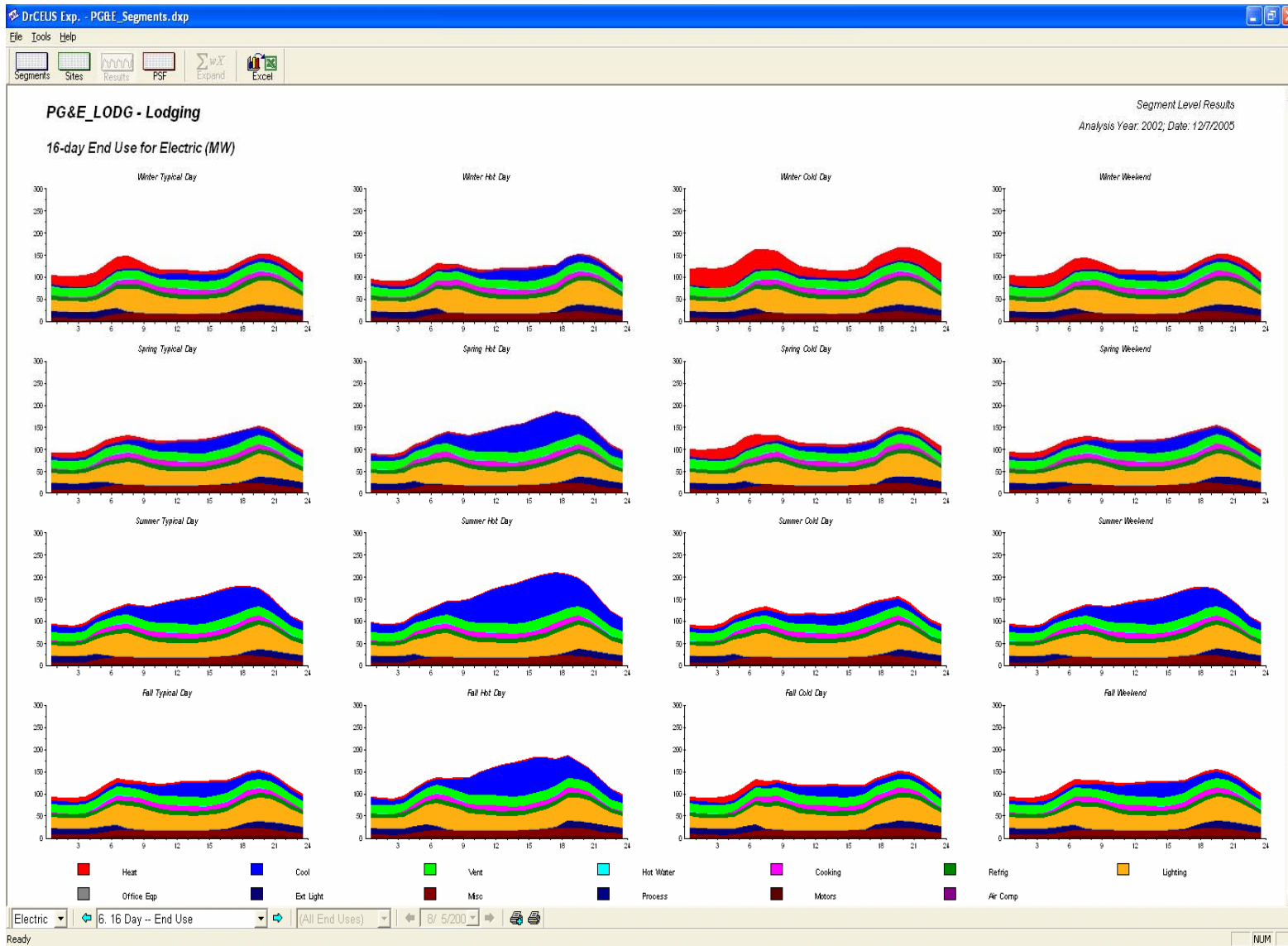


Figure 9-17: Miscellaneous 16-Day Hourly End-Use Shapes

