Characteristics and Energy Use of the Convenience Store Industry

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REPORT SUMMARY

Energy efficiency measures could reduce a convenience store's energy costs by 25% and improve a typical return on investment by about 10%. This report assesses opportunities for improving convenience store energy efficiency by installing energy-efficient lighting systems, refrigeration controls, and display case antisweat heater controls.

Background

The 24-hour convenience store (c-store) ranges from 800-4000 ft^2 in size with a four-to five-space parking lot and contains coolers for beverages, ice cream, and grocery items. Typical formats range from mini, limited selection, and traditional to expanded, hyper, and kiosk stores, with two types of operators - - traditional and petroleum marketers. By 1990, this industry had reached a total of 84,500 businesses throughout the United States, with the largest concentration in the southeast.

Objectives

To provide an overview of the c-store industry and its energy use; to assess opportunities and potential for improving c-store energy efficiency.

Approach

The project team consulted industry publications to define a c-store and determine typical store formats, operators, size, operating hours, and geographic areas in which stores are most often found. Using this information, they created a business and market profile. Through telephone interviews with c-store companies, design firms, equipment manufacturers, and utilities, the project team then estimated c-store energy use and costs for refrigeration, lighting, heating and air conditioning, water heating, and food service. They also assessed the industry's level of interest and activity in improving energy efficiency.

Results

The business profile indicated that the c-store market is saturated and becoming increasingly competitive. Store size, age and location vary, but estimates indicate an annual c-store electricity use of approximately 100 kWh/ft^2 or 19.2 billion kWh. Utility costs for such use range from \$8.75-\$12/ft^2 and represent about 14% of a store's direct operating costs. This cost could be reduced by more-efficient energy use through the installation of such features as energy-efficient lighting systems as well as refrigeration and display case antisweat heater controls. Overall, an estimated 25% reduction in

utility costs could be achieved, improving a store's typical return on investment by about 10%.

EPRI Perspective

The c-store industry represents an important small business utility customer, and utilities are interested in helping c-stores use energy efficiently. This report characterizes the present c-store industry and presents cost-effective, state-of-the-art measures for enhancing energy efficiency. Related EPRI work includes an *Assessment of Refrigerated cases* (report TR-103981).

TR-103982

Interest Categories

- Heating, cooling, and refrigeration
- Lighting and appliances

Keywords

- Convenience stores
- Energy efficiency
- Demand-side
- management
- Refrigeration
- Small businesses

ABSTRACT

The Electric Power Research Institute (EPRI) initiated a project to 1) provide an overview of energy consumption in the convenience store (c-store) business segment, and 2) assess opportunities for improving c-store energy efficiency. Project findings revealed that annual c-store energy consumption is approximately 100 kWh/sq.ft. On the basis of 84,500 stores in the United States, this translates to 19.2 billion kWh used annually. Typical annual utility costs range from $8.75 to $12 per square foot, and represent about 14% of a store's direct operating costs. This cost could be reduced by more efficient use of energy through the installation of such features as energy efficient lighting systems, refrigeration controls, and antisweat heater controls. An estimated reduction in utility costs could be achieved and could improve a store's return-on-investment from 9 to 10%.

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1

INTRODUCTION

Even with the bankruptcy filings of major players, the number of convenience stores (c-store) in the United States is on the rise. According to the *Convenience Store News 1991 Industry Report (CS News Industry Report),* the c-store industry grew by 1,500 stores from 1989 to 1990 reaching a total of 84,500. The market growth is due to the efforts of major oil companies and petroleum marketers. The number of more traditional c-stores actually dropped from the previous year.

Electric energy use by this market sector is significant. The annual electric energy use for a c-store is approximately 100 kWh/sq.ft. Using figures for the number of c-stores in different size categories, this translates to a total annual electric energy consumption of approximately 19.2 billion kWh for the c-store industry.

The following is a report on the c-store industry's energy use and potential for improving energy efficiency. The information presented has been obtained from industry publications and several telephone interviews with c-store company executives, designers, and equipment manufacturers.

The report is organized into six chapters. A chapter defining c-stores and their characteristics follows. Information on the business operations of the industry and leading companies is presented in Chapter 3. The energy use and equipment characteristics of c-stores are presented in Chapter 4 followed by c-stores interest and activity in improving energy efficiency in Chapter 5. Finally, a brief summary of report conclusions is provided in Chapter 6, and an appendix contains case studies.

2

C-STORE CHARACTERISTICS

2.1 Definition

Two primary sources of published information regarding the c-store market are *Progressive Grocer's 1991 Directory of Convenience Stores* (PG 1991) and the 1991 *CS News Industry Report.* Each of these sources has a slightly different definition of a c-store.

PG defines the c-store as a "Compact drive-to store offering a limited line of high convenience items. Over half sell gasoline and some sort of fast food. Stores are open long hours and provide easy access."

The *CS News Industry Report* defines the c-store in more specific terms:

- The size must be between 800 and 4,000 sq.ft.
- The store must contain coolers for beverages, candy, and possibly some grocery items, and
- It should have a parking lot with 4 to 5 parking spaces.

Although these definitions differ only slightly, the total number of c-stores is significantly different (56,000 for PG, 84,500 for CS *News Industry Report).* According to CS *News Industry Report,* the discrepancy can be found in a large number of independent c-stores, which PG does not include. *CS News Industry Report* includes more information from the large oil companies, a segment that is lacking in the PG report. PG uses only information that is signed off by company officials, and many of the large oil companies refused to do this. The 84,500 is believed to be more representative. However, some information from the PG report will be presented in this report.

2.2 Store Formats

The National Association of Convenience Stores (NACS) defines six formats for c-stores: Mini, Limited Selection, Traditional, Expanded, Hyper, and Kiosk (Adams 1986).

2.2.1 Mini

The mini c-store is usually between 800 and 1,200 sq.ft. in size and has an emphasis on gasoline sales. It usually has a small selection of grocery items and little or no food service. It is open between 18 and 24 hours.

The mini c-store is very popular with oil companies. The advantage of this type of store is simplicity of operations thus requiring limited training and supervision. The drawback is that the profitability of these stores is highly dependent on volatile gasoline margins.

2.2.2 Limited Selection

The limited selection c-stores ranges in size from 1,500 to 2,200 sq.ft. These stores have a broader mix of products and groceries than the mini c-store, but selection is relatively limited when compared to the traditional c-store. It usually has simple food service such as hot dogs, popcorn, etc. It is often affiliated with oil companies, and gas buyers are the main customer.

2.2.3 Traditional

The traditional c-store is about 2,400 to 2,500 sq.ft. in size. It carries a varied product mix including dairy, bakery, snack foods, beverages, tobacco, grocery, health and beauty aids, fresh or frozen meats, gasoline, and limited produce items. It may also have video games, a bank machine, and a microwave. Many of these are open 24 hours per day, and have between 6 and 12 parking spaces. Most of the original c-stores fall into this category and are owned by c-store chains, but oil companies have also built or acquired this type of store.

2.2.4 Expanded

A growing segment of the c-store market is the expanded c-store, which is between 2,800 and 3,600 sq.ft. These stores can accommodate additional shelves for groceries or room for significant fast food operations and seating. Many c-store chains see the move toward more fast food as essential because of the increased competition from the oil companies in the smaller store format. These stores attract a broader range of customers than the traditional c-stores.

2.2.5 Hyper

Very large c-stores, or hyper c-stores (4,000 to 5,000 sq.ft) offer an array of products and services arranged in departments. For example, they may have a bakery, a sit-down restaurant area, a pharmacy, etc. Many of them sell gasoline, and in some locations

they serve as mini truck stops. They usually require a large parking lot because the average customer spends more time in the store.

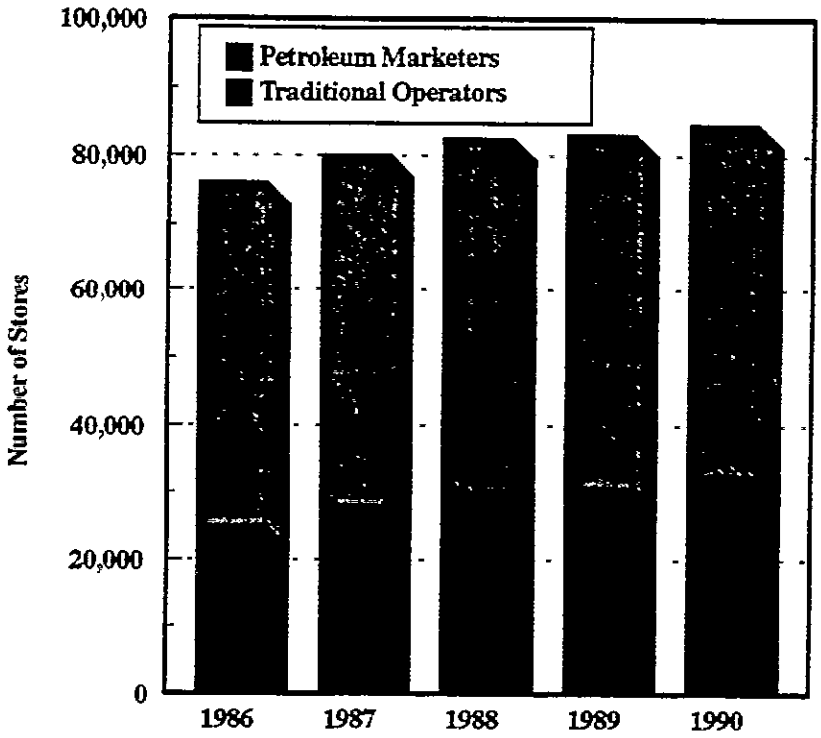
2.2.6 Kiosk

Another type of store that is not considered a c-store by either PG or CS *News* definitions is the "kiosk." This type has less than 800 sq.ft. and offers some convenience items such as tobacco, beverages, and snacks. The focus of these stores is gasoline sales. There is usually no parking except at the pumps and there are no grocery items.

2.3 Store Operators

There are basically two types of c-store operators within the c-store industry, "traditional operators" and "petroleum marketers." The distinction is the stores' origin. The traditional operators originated with the intent of operating c-stores, with gasoline as an option. The petroleum marketers, however, began with petroleum products and added the c-stores later. The petroleum marketer segment includes stores run by major oil companies, oil jobbers who entered the gasoline retail business, and former gas-only retailers who added the c-store aspect.

Over a five-year period (1986-1990), the c-store market has shown steady growth from 76,000 stores in 1986 to 84,500 stores in 1990 (Figure 1). The major portion of the growth has been from petroleum marketers, increasing from 25,000 to 32,500 stores. The traditional operators' segment increased by only 1,000 stores during this period.



Source: *CS News Industry Report* 1991

Figure 1. Five Years of C-Store Growth

2.4 Store Size

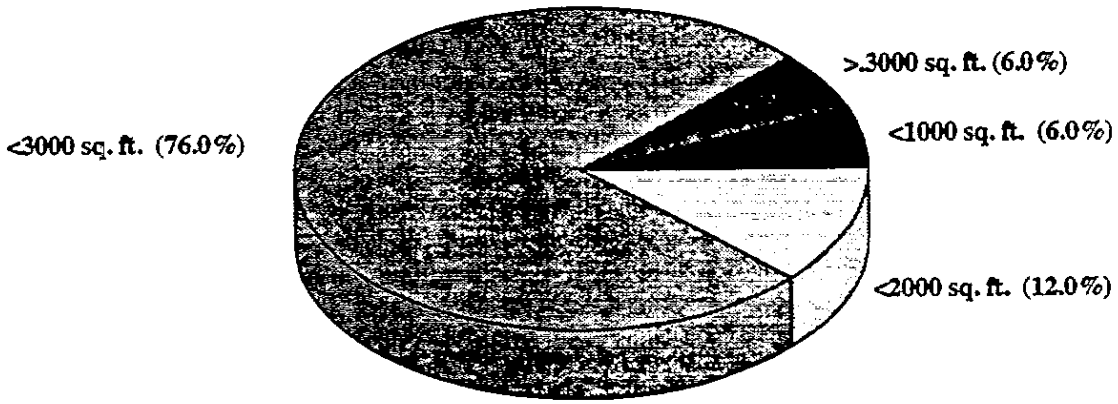
Both types of operator, petroleum and traditional, use the five formats discussed earlier. However, the petroleum marketer stores are typically smaller, which is consistent with gas sales being the merchandising focus. In 1990, 79% of the c-stores that originated as petroleum marketers were less than 2,400 sq.ft. in size, while those stores that originated as c-stores have the majority in the mid-sized range (between 1,800 and 3,000 sq.ft).

Table 1, shows that traditional c-stores are 24% larger on average than the petroleum operators' stores.

Table 1. C-Store Size Distribution

Ave. Sq.Ft.	Traditional Operators	Petroleum Marketers
<1800	7%	42%
1800-2399	38	37
2400-2999	42	17
>=3000	13	4
Average	2500 sq.ft.	1900 sq.ft.

Figure 2 looks at the c-store market as a whole. Most of the c-stores range in size from between 2,000 and 3,000 sq.ft. The fastest growing segments of the c-store market are the non-traditional stores, or store formats other than 2,400 sq.ft., even though this size is still very popular.

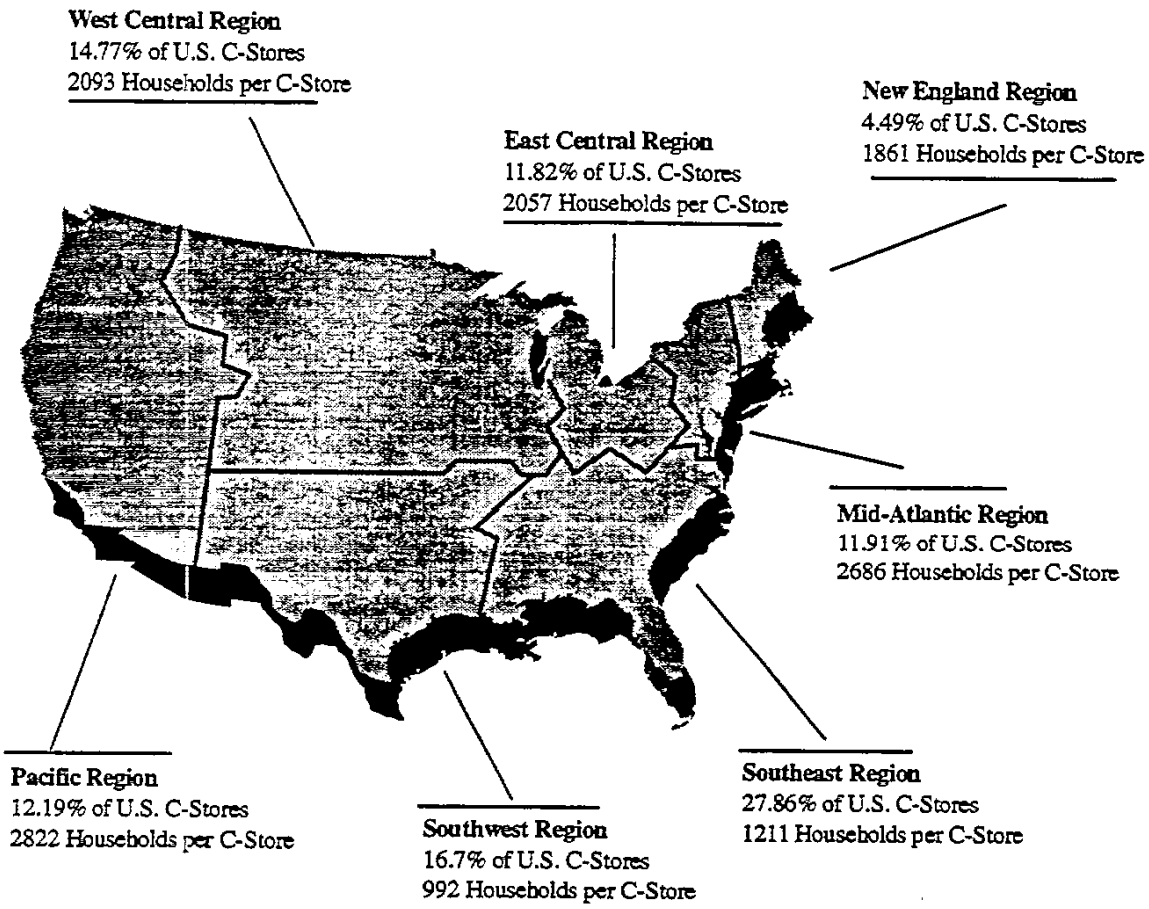


Source: Gerke 1990

Figure 2. Percent of C-Stores by Size (sq.ft.) 1987

2.5 Geographic Market Areas

Figure 3 provides a nationwide distribution of c-stores. The largest concentration of c-stores is in the southeastern portion of the United States. Nearly 45% of all c-stores can be found in the southeast and the southwest regions combined.



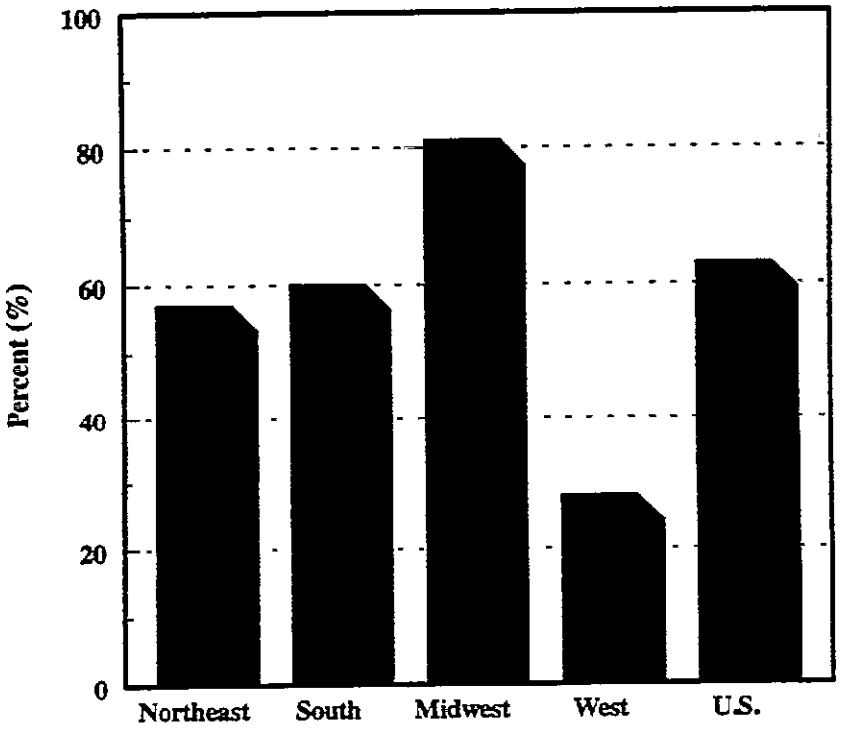
Source: *PG* 1991

Figure 3. C-Store Market Distribution

2.6 Operating Hours

Many c-stores are open 24 hours per day, and the rest are generally open between 18 and 24 hours.

As shown in Figure 4, the Midwest has the largest percentage of c-stores that are open 24 hours, while the West has the lowest percentage. For the entire United States, 63% of the c-stores are open 24 hours.



Source: *CS News* 1991

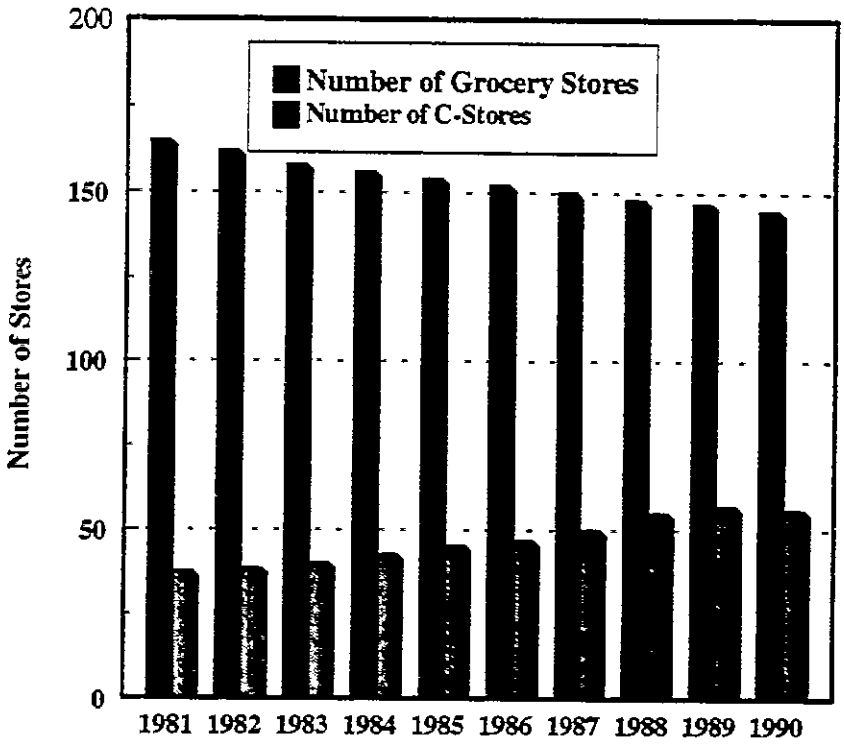
Figure 4. C-Store 24 Hour Operation by Region

3

C-STORE BUSINESS AND MARKET PROFILE

The c-store market is believed to be at the saturation level, and thus it is increasingly competitive. Small c-store chains and individual c-stores are consolidating. Many traditional c-store operators are downsizing and concentrating on improving existing stores by changing the product mix and enhancing customer service. The larger oil companies continue to buy and build stores and experiment with different store design and sales strategies. Operators are more price sensitive and cost conscious because of the increased competition. Several of those surveyed indicated a strong interest in saving money through energy efficiency.

According to the *PG*, the gap between the number of c-stores and the number of grocery stores is narrowing. As small grocery stores have closed and been replaced by larger stores serving larger areas, the role of the c-store has grown. In fact, if the number of c-stores from *CS News* is used, the difference in the number of grocery stores (89,000) and the number of c-stores (84,500) is relatively small (4,500) (Figure 5).



Source: *PG* 1991

Figure 5. Number of C-Stores vs. Number of Grocery Stores

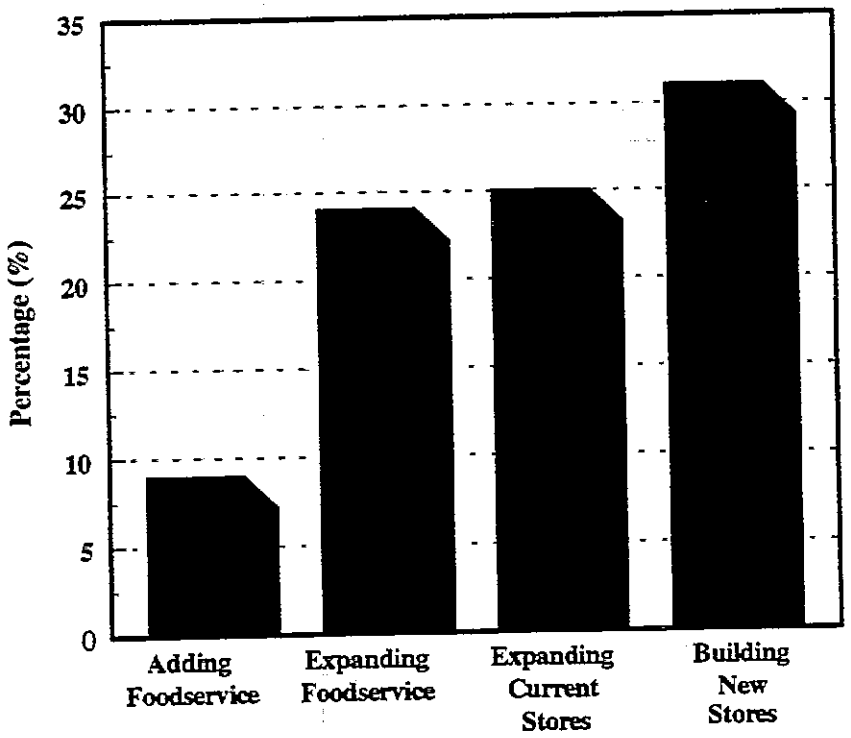
All of the store formats can be profitable in the U.S. market. A NACS study (Gerke 1990) examined the return-on-investment (ROI) for each of the five major formats at a $0.09 per gallon gasoline margin. The results are presented in Table 2.

Table 2. Return on Investment by Store Format

Traditional	9%
Mini1	6%
Limited Selection	13%
Expanded	16%
Hyper w/gas	16%
Hyper w/o gas	15%

The traditional c-store has the lowest profit margin, which may explain the bankruptcy filings of chains operating this type of store.

Although there is much consolidation and regrouping in the industry, many c-store chains are planning to expand and upgrade their stores. According to *CS News* over 30% are planning to build new stores, and 25% are planning to expand existing stores (Figure 6). Much of this expansion includes additional food service equipment.



Source: *CS News* 1991

Figure 6. C-Store Expansion Plans

Table 3 presents the top 25 c-store companies and store operating names according to *CS News.*

Table 3. Top 25 C-Store Companies and Store Operating Names

	Company	Key Chain(s)	Total Stores
1.	The Southland Corp. Ito-Yokado	7-Eleven	6,705
2.	Amoco Corp.	Amoco Food Shops, Split Second	6,350
3.	Chevron Corp.	Food Mart	3,999
4.	The Circle K Corp.	Circle K Food Stores	3,865
5.	Mobile Corp.	Mobile Mart	2,200
6.	Texaco Inc.	Food Mart, Star Mart	1,244
7.	Dairy Mart Convenience Stores Inc.	Dairy Mart	1,189
8.	Marathon Oil Co.	Speedway, Checker, Gastown, United	1,134
9.	Cumberland Farms	Cumberland Farms	1,129
10.	National Convenience Stores	Stop N Go	1,071
11.	Silcorp Ltd.	Mac's Convenience Stores, Hop-in	999
12.	Dillon Companies Inc.	Kwik Shop, Quik Shop, Loaf N Jug, Mini Mart, Turkey Hill Minit Markets, Tom Thumb, Time Saver	958
13.	Shell Oil Co.	Food Mart	900
14.	BP Oil Co.	BP Shop	880
15.	The Coastal Corp.	Coastal Mart	800
16.	Casey's General Stores, Inc.	Casey's General Stores	779
17.	Atlantic Richfield Co.	am/pm	760
18.	Becker Milk Co.	Becker's	688
19.	Diamond Shamrock Inc.	Corner Stores	677
20.	Ashland Oil Corp.	SuperAmerica	660
21.	Kampgrounds of America	Kampgrounds of America	650
22.	Total Petroleum Corp.	Total Mart, Vickers, Road Runner	631
23.	Exxon Corp.	Exxon Shop	629
24.	Getty Petroleum Corp.	Getty Mart	591
25.	Crown Central Petroleum Corp.	Crown, Fast Fare, Zippy Mart	550
	Total		**40,038**

source: *CS News Industry Report 1991*

The top 25 companies account for nearly 50% of the total c-store market in terms of number of stores. The top five companies represent 27% of the market, with the large oil companies beginning to dominate the c-store store industry. It should be noted, however, that the Amoco and Chevron figures include 6,908 jobber- and 25,75 dealer-operated stores. Amoco and Chevron together only have 866 company-operated stores. Corporate level decisions regarding energy efficient design and equipment specifications would probably only impact the company-operated stores.

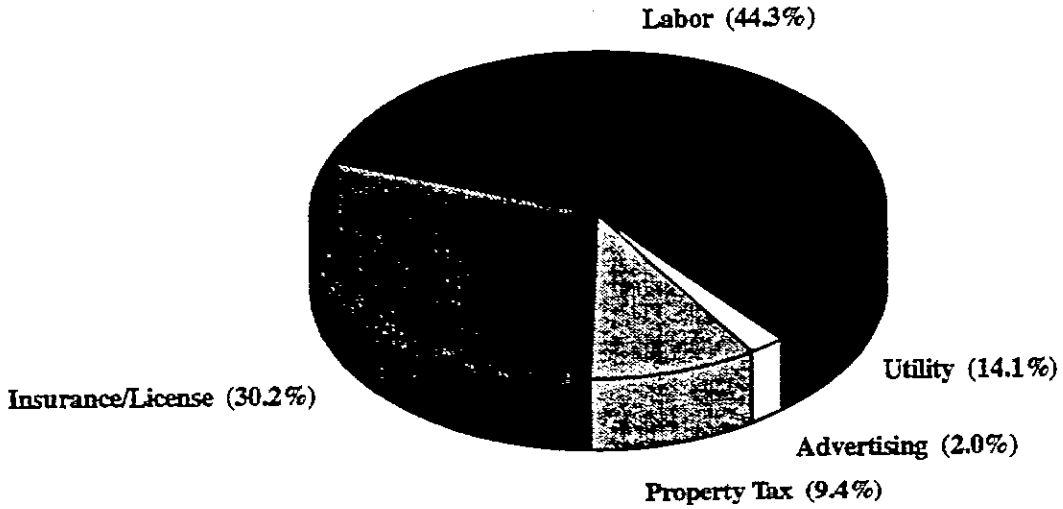
Even after emerging from bankruptcy court, Southland Corporation is still the leading c-store operator with approximately 6,700 stores throughout the United States. However, Southland does intend to close over 100 stores every year for the next several years. Southland's presence will remain strong in California, Virginia, Florida, and Texas where 46% of the stores are located.

While Southland has emerged, Circle K and National Convenience Stores remain in Chapter 11 bankruptcy court protection. Circle K has no building, remodeling, or acquisition plans and has announced that it intends to sell 40% of its 3,865 stores and withdraw from 14 of the 32 states in which it operates (EEI 1992). National Convenience Stores is expected to continue the consolidation of its operations to nine cities primarily in Texas.

4

C-STORE ENERGY USE AND COSTS

A NACS study estimates that the total direct operating expenses for the traditional 2,400 sq.ft. c-store are approximately $149,000 per year (Gerkey 1990). The utility expenses represent 14% of this total or $1,700/month. The breakdown of the remaining expenses is shown in Figure 7.



Source: Gerke 1990

Figure 7. Annual Store Direct Operating Expenses

As expected and confirmed during the telephone survey, the actual utility expense varies significantly with location because of differences in rates. One cc-store chain stated that monthly electric bills were less than $700 in the Northwest with electricity at $0.03/kWh, but closer to $3,800/month in New York with $0.14/kWh electricity. These

cost figures suggest monthly electric use of approximately 25,000 kWh. Another mentioned bills ranging from $800 to $2,800/month.

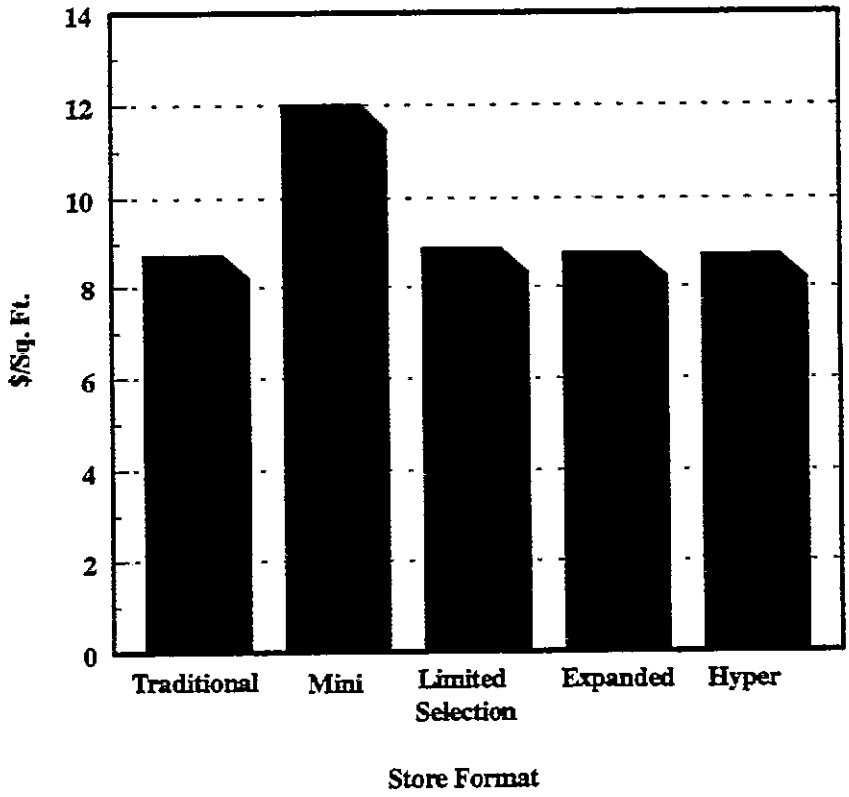
Figure 8 shows a comparison of the utility cost per sq.ft. of store area for the five c-store formats.

A 25% reduction in energy use through improvements in energy efficiency could save $3,000 to $8,750 annually. For the traditional store, this could increase the return-on-investment from 9 to 10%.

A breakdown of the energy use of traditional c-stores, provided by one of the survey respondents from a leading nationwide chain, is given in **Figure 9**. This also varies with climate differences and stores. Some stores have more frozen food cases while others provide more food service.

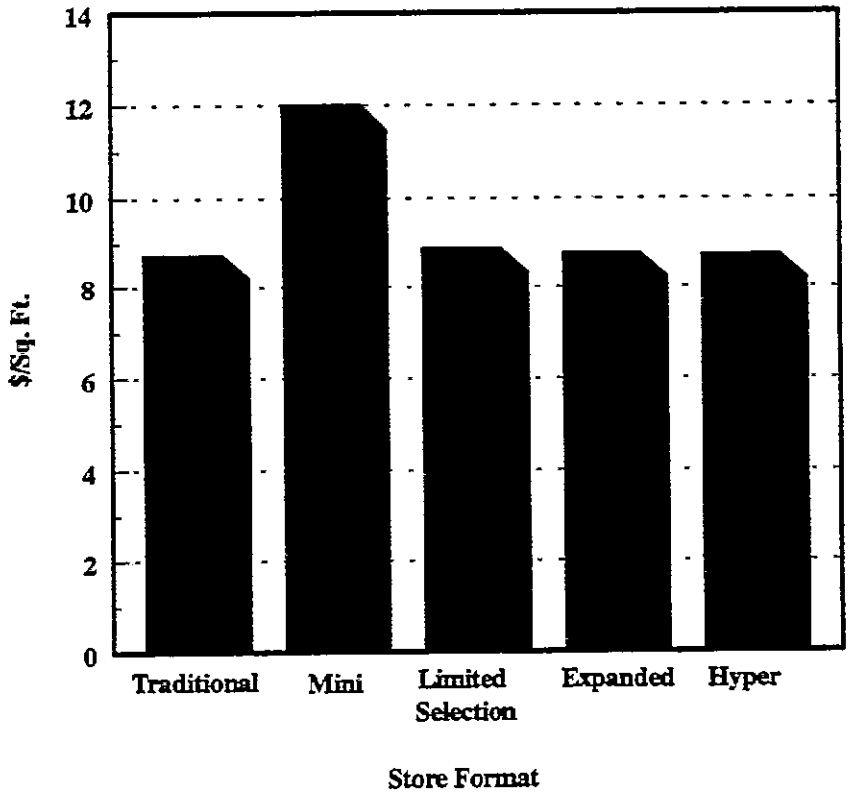
Pacific Gas and Electric (PG&E) conducted end-use metering in commercial buildings (PG&E 1992). The results of this monitoring for c-stores portray a similar breakdown of annual electric energy use. (**Figure 10**).

C-stores have a relatively small variation in load throughout the day, primarily because most of these are open 18 to 24 hours per day. **Figure 11** shows the average weekday load shape broken down by end use. These data were also obtained as part of the PG&E study (PG&E 1992). More information regarding the PG&E end-use metering can be found in the Appendix.



Source: Gerke 1990

Figure 8. C-Store Annual Utility Cost by Store Format ($/sq.ft.)



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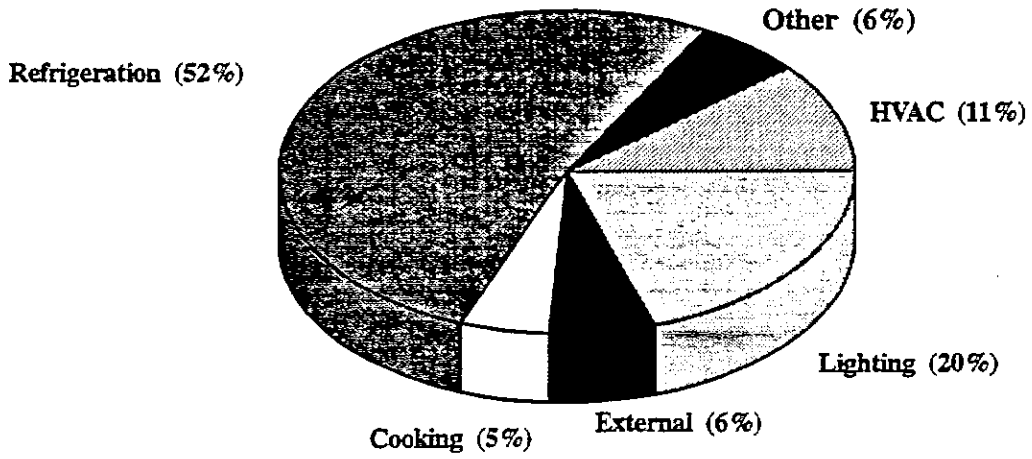
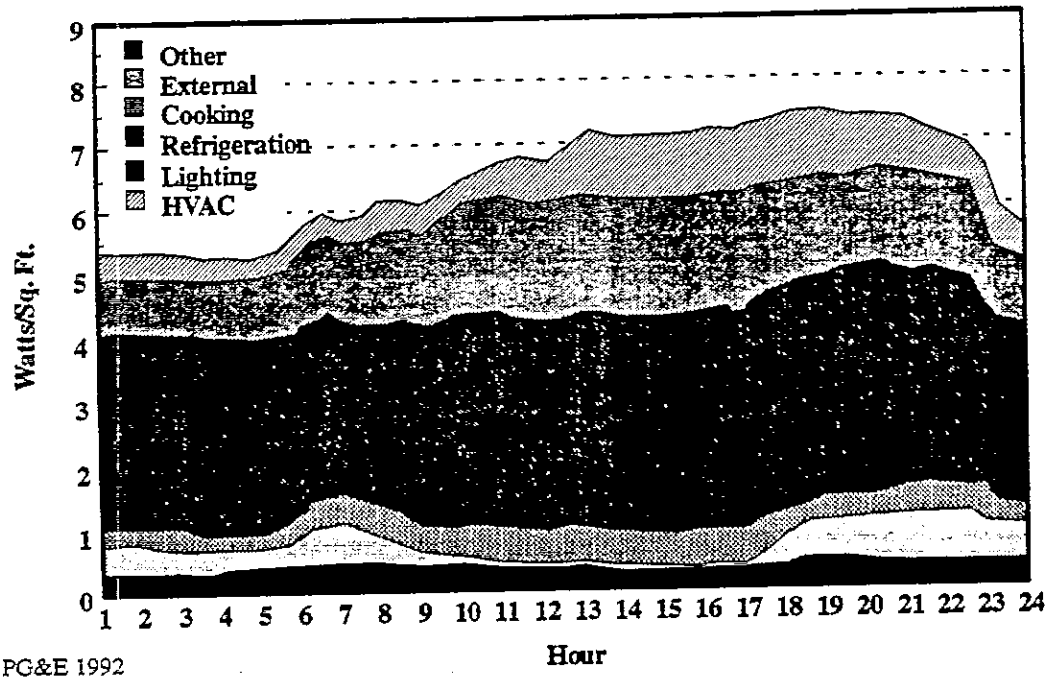


Figure 10. Annual Electric Energy Shares



Source: PG&E 1992

Figure 11. Average Weekday Load Shape with End-Use Consumption

Figure 12 shows the energy use of an 1,800 sq.ft. c-store in the Midwest. The monthly energy use remains relatively constant throughout the year. Note that cooling energy causes a large peak during the summer months, especially August. The peak demand for this store was approximately 41 kW (22.8 watts/sq.ft.) and occurred in July and then again in October. The smallest peak demand was approximately 34 kW in April.

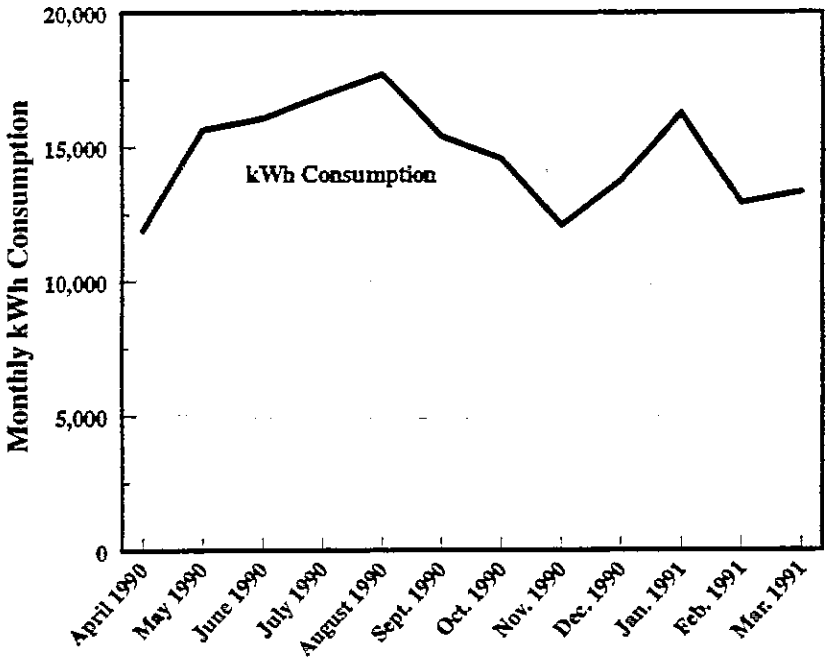


Figure 12. C-Store Electric Use

4.1 Refrigeration

As indicated by the three previous figures, refrigeration accounts for the largest share of energy use in c-stores. In the traditional and larger c-stores, refrigeration is primarily the walk-in cooler located at the back of the store. There may be a walk-in freezer for frozen foods as well. Smaller stores tend to use more self-contained display units throughout the store. The self-contained units such as that shown in Figure 13 are favored because they may be easily moved to another location and the fractional horsepower units do not justify the expense of remote installation.

The walk-in cooler is used for both storage and as a display case. As shown in Figure 14, one wall of the cooler is equipped with shelving and doors for merchandising the product. The energy use of the lighting and door antisweat heaters is significant, as much as half of the total walk-in cooler energy use. The common situation is to have the antisweat heaters and lights on constantly.

Condensation on the display doors of the walk-in coolers is a significant concern because of its impact on sales. Most designs for the medium temperature coolers do not have heated glass, but have heaters in the door frame and mullion. The low temperature coolers use triple pane glass with heaters.

Inadequate maintenance can result in increased refrigeration energy use. Dirty condensers and debris inside cases can cause compressors to operate for longer periods, increasing energy consumption.

Leading door manufacturers do offer energy saving features such as gas fills, reflective coatings, and humidity or dewpoint sensors to control the heaters. Product data provided by one manufacturer suggest a payback of just over five years for their energy saving product in a 12-door cooler at an electricity cost of $0.08/kWh. This is based upon antisweat heater energy savings only. Commercial Refrigerator Door Company claims to have the first door system to be completely energy free by using vinyl frames, foam insulation, and a thermal break, thus eliminating the need for heaters.

R-12 and R-502 are the primary refrigerants used in c-store refrigeration systems. Some chains are using R-22 in their new stores, but not without concerns for their performance. The environmental regulations imposed on this industry's underground fuel storage tanks have made them very sensitive to the CFC issue.

Refrigeration manufacturers are seeking new refrigerants to replace R-12 and R-502, which are scheduled to be banned for new equipment in 1996. HCFC R-22 has been touted by some manufacturers as being a short-term replacement for R-12 and R-502. However, this refrigerant does not provide energy savings especially in the c-store sized applications because of its lower heat transfer efficiency. Refrigerants R-134a and HP-62 will potentially be available within two years and offer more meaningful solutions to energy efficiency problems.

Leading refrigeration equipment manufacturers are Hussmann, Universal Nolin, Master Bilt, and True Food Service. The principal door manufacturers are Ardco, Anthony, and Commercial Refrigeration Door. Mantinowoc Equipment Works and SerVend International are leading manufacturers of ice cube machines and combination ice cube/beverage dispensers.

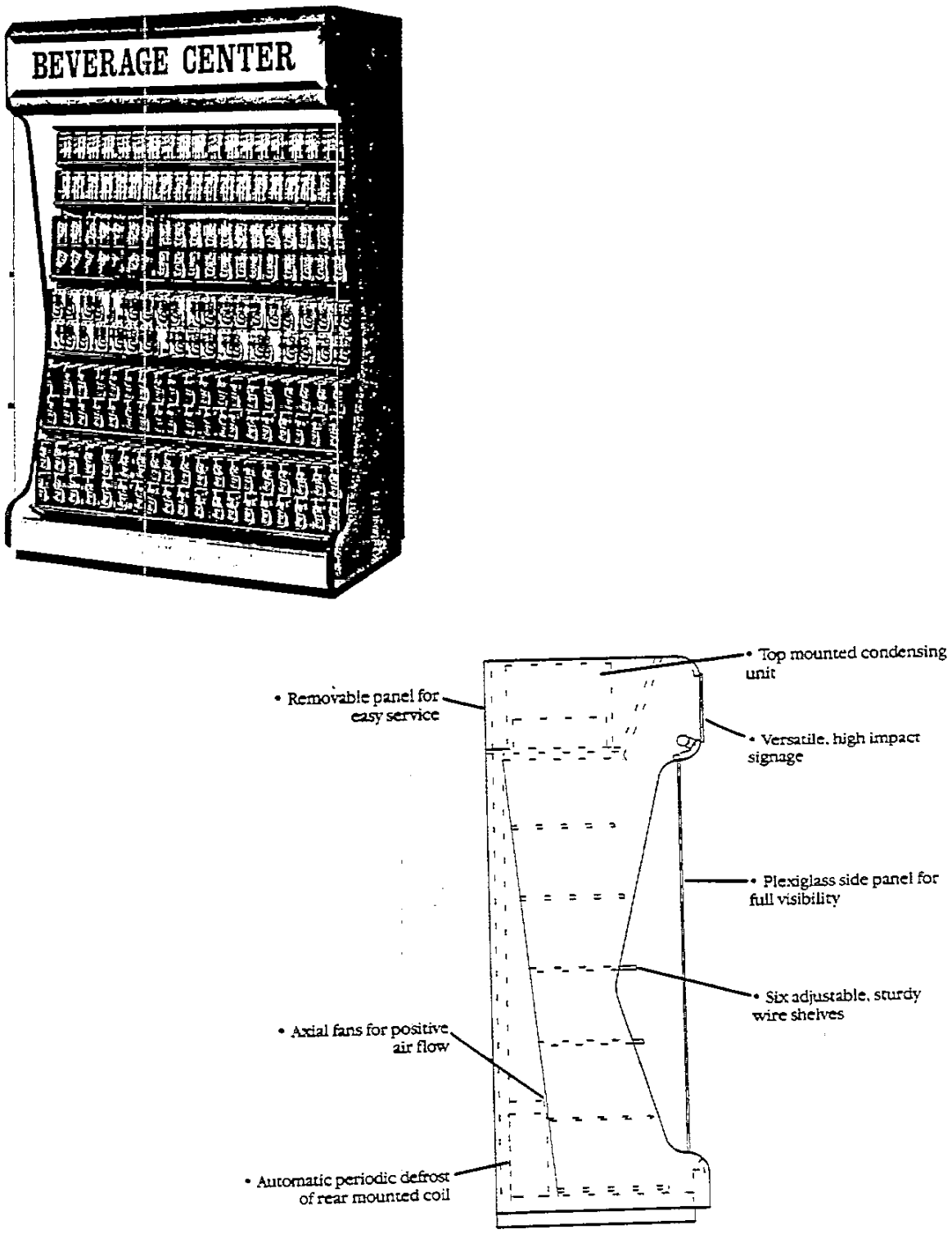


Figure 13. Self-Contained Units

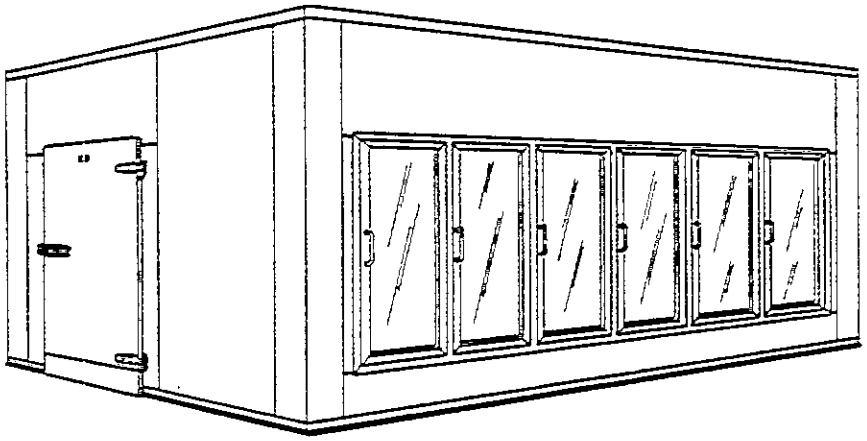


Figure 14. Walk-in Cooler

4.2 Lighting

Lighting is of utmost importance in the c-store industry from the standpoints of sales and safety. Displays, walkways, and food service areas must have adequate lighting for proper enhancement of products and customer access. Lighting energy is approximately 20% of the c-stores' energy use. The energy study conducted by Iowa Public Services for Casey's General Store (see the Appendix) indicated that the lighting load was approximately 20.66 kWh/sq.ft. on an annual basis. One of the survey respondents estimated 2.5 W/sq.ft. as the interior lighting load, which compares with 2.36 W/sq.ft. for the Casey's General Store study.

Metal halide high intensity discharge lighting is used for the outside lighting. Outdoor lighting is also very important for the safety of store clerks and customers. Most data sources do not distinguish between indoor and outdoor lighting, but the Casey's study indicated approximately 19% of the stores' total energy was used for indoor lighting and 2% for outdoor lighting. This breakdown can vary significantly among c-stores depending on the number of outdoor gas pumps and parking lot size.

The top three energy conservation measures specified by the Casey's General Store study were improvements in lighting. These three measures include: upgrade existing fluorescent fixtures, replace designated incandescent lighting with fluorescent, and install energy efficient lamps. Lighting upgrades can be a cost effective way for c-stores to conserve energy.

4.3 Heating and Air Conditioning

The heating and air conditioning of c-stores are primarily accomplished by one or two packaged rooftop units. Total capacity ranges from 5 to 20 tons depending upon the size and location of the store. Some chains only condition the front entrance/check-out area and the center aisle of the store.

It is common for c-stores to shut off air conditioning systems at night in order to reduce energy use. One respondent indicates that this practice saves air conditioner energy use, but may result in increased refrigeration energy. When the air conditioning is not running, the refrigerated cases are exposed to a higher ambient temperature causing their compressors to operate more. Also, at night the cooling load is reduced because of reduced lighting, absence of people, and reduced operation of food service equipment. Therefore, shutting the air conditioning off at night may not save much, if any, energy.

Electric resistance is often used for heating because the low heating loads do not justify the expense of installing gas lines and monthly meter charges. Heat pumps are used by some stores, but many feel that their expense can not be justified because the store's heating loads are at low ambient temperatures.

Economizers are either being used or reconsidered now that controls have improved. One survey respondent stated that in the past the use of economizers had caused a significant increase in their maintenance contract cost, making them uneconomical.

Heat reclaimed from the refrigeration circuit is typically not used for space heating. The complexity and cost of adding heat reclaim can not be justified by the relatively low space heating loads.

Lennox, Carrier, Trane, and York are leading manufacturers of HVAC equipment used in c-stores. The survey findings suggest that the packaged combination HVAC/refrigeration systems manufactured by Phoenix Refrigeration, Air Conditioning Specialist, and Hussmann are not in widespread use.

4.4 Water Heating

The energy consumption associated with water heating is considered minimal. Small 15 to 50 gallon electric storage water heaters are commonly used. Hot water is

generally used during off-peak hours for clean-up of food service utensils. C-stores with a deli and food preparation areas use the larger size tank.

The complexity and cost of using reclaimed heat from the refrigeration equipment for water heating is considered unjustified.

4.5 Food Service

The extent and type of food service equipment varies, but may include microwaves, hot food warmers, hot dog cookers, popcorn machines, and coffee machines. New and remodeled stores are expanding their food service capabilities. **Figure 15** presents percent saturation of different types of food service equipment.

Food service equipment is viewed as a necessity with little attention given to its energy use. However, one survey respondent did note that they stagger the starting of the coffee machines to avoid peak-demand charges.

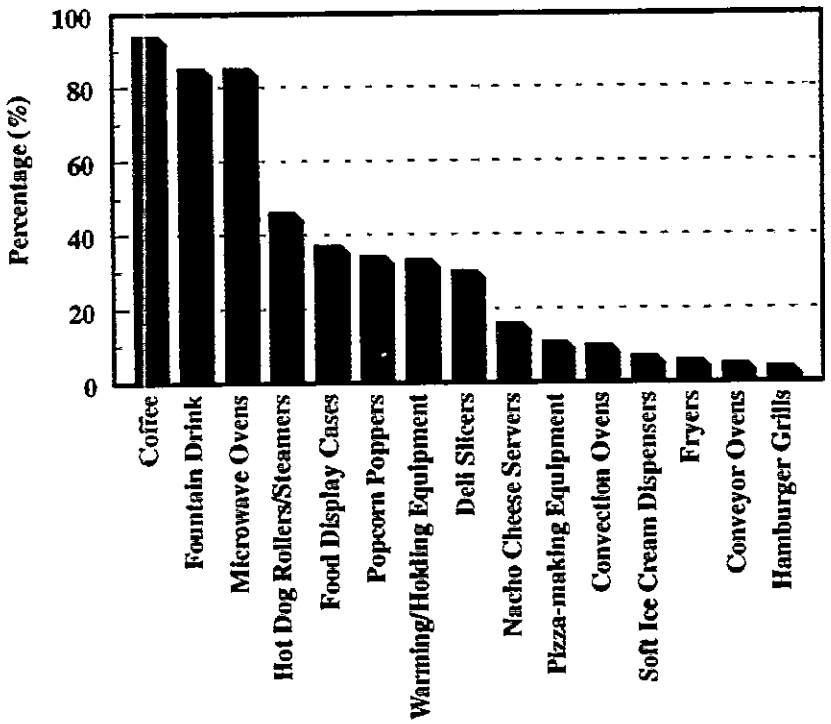


Figure 15. C-Store Food Service Equipment Saturation

One of the case studies in the Appendix included the monitoring of a pizza oven in a Village Pantry c-store. **Figure 16** shows the energy use of this type of oven, in addition to the total energy use over a 24-hour period. Note that the energy demand peaks at around 8 kW and averages approximately 6 kW through the store operation time. Although this is not the norm, it does illustrate how food service equipment can be significant in terms of energy consumption.

4.6 Other

The general trend in c-stores is toward increased electric use. Many remodels require an upgrade of electrical service to accommodate increased food service equipment and additional equipment such as video game machines, automatic teller machines, and check-out scanning systems.

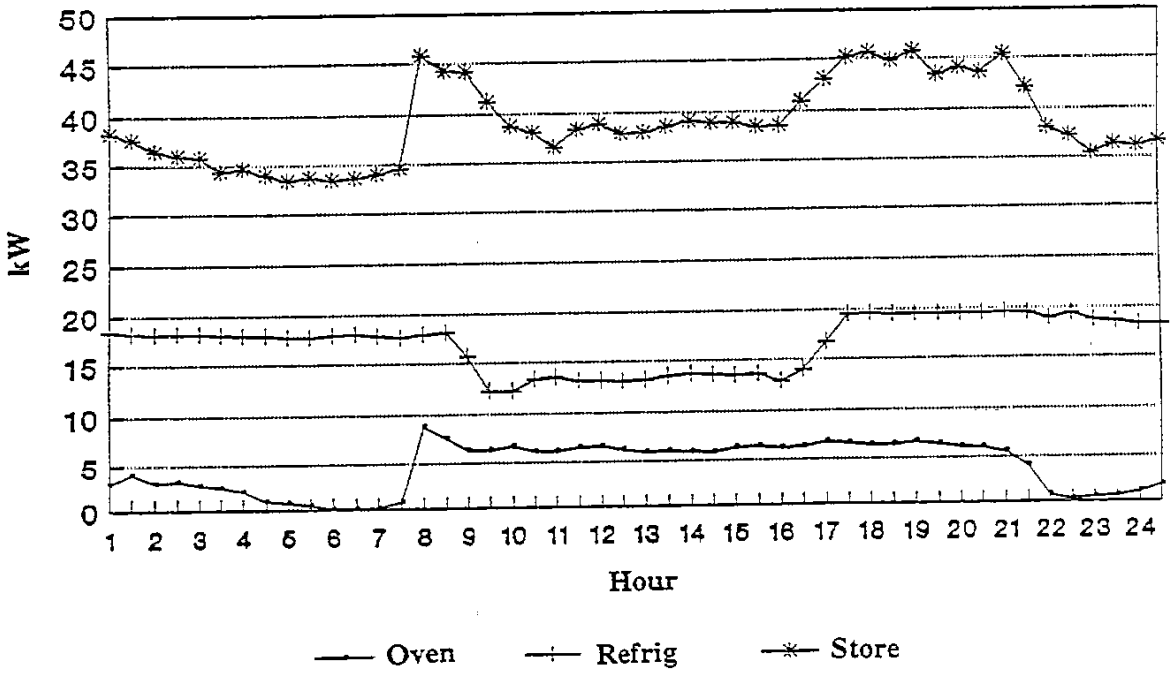


Figure 16. Energy Use of the Village Pantry

5

C-STORE INDUSTRY ENERGY EFFICIENCY INTEREST AND ACTIVITY

5.1 Interest in Energy Efficiency

The level of interest of the c-store industry in improving energy efficiency seems to vary with industry players. The following are generalizations based upon the telephone survey findings.

5.11 C-Store Companies

Many are very interested in improving energy efficiency as a means to save money. To please shareholders, there is some interest in being environmentally responsible. Interest in cooperating with EPRI in a demonstration project was expressed by most of the chains contacted.

There is some skepticism toward gimmicks or black boxes. It seems as though many have had bad experiences with past attempts to save energy.

5.1.2 Private C-Store Design Firms

Several c-store companies have hired private design firms to develop the design for their prototype stores. The prototype design is then tested and, if successful, reproduced for other stores.

The priority of these design firms is store sales volume and they believe that it is their client's only concern. Their responsibilities are more aesthetic in nature, but some of the decisions made at this level impact the options available to the builder of the store.

These design firms specify the amount and positioning of glazing and lights. Energy efficient lighting meant reduced lighting levels to one designer and thus was unacceptable.

5.1.3 Equipment Suppliers

Manufacturers of equipment for the c-store market state that there is an interest in reducing energy consumption, but reception of their more energy efficient products has been poor. First cost is an important issue along with the risk associated with trying something new. Nonetheless, products are available and there is an interest in working with EPRI to demonstrate these products to the industry.

5.2 Activity to Improve Energy Efficiency

As proof of their interest, the following are examples of activity to reduce energy use in the c-store industry.

5.2.1 Southland Corporation (Dallas, TX)

Due to the new majority ownership of Southland Corporation, every aspect of the operation of its 6,700 7-Eleven stores is being reevaluated. The current focus is on improvements to existing stores. Activities being considered include relamping with T-8 lamps and electronic ballasts, new HVAC equipment and new refrigeration equipment.

Southland is also moving to a centralized organization so that nationwide equipment supply and maintenance contracts will be established. They currently operate with regional offices. Thus, central office decisions will impact a huge number of c-stores.

5.2.2 Diamond Shamrock Inc. (San Antonio, TX)

Diamond Shamrock operates 677 Corner Stores in Texas, Colorado, and Louisana. In 1990, they introduced the "Sterling Design" which included a more efficient lighting system. This lighting system is now being retrofitted in all of their stores.

The previous lighting system had used four F40T10 lamps in each trougher. The new system uses two F40T12 lamps with electronic ballasts and reflectors. Lumen output is actually higher and wattage per trougher was reduced by 63%.

5.2.3 Sheetz Inc. (Altoona, PA)

Sheetz operates 158 stores in Pennsylvania, Maryland, and West Virginia. While it is one of the smaller c-store companies, ranked number 54 by *CS News*, it is growing. It is also quite visible in the industry, with President Steve Sheetz as last year's Chairman of the Board for the NACS.

Sheetz appears to be a leader in terms of efficient energy use. Its lighting systems employ energy efficient ballasts and bulbs. It uses a floating head pressure system on the walk-in cooler and freezer along with the more advanced insulated doors.

Sheetz also has its own maintenance department which conducts monthly preventative maintenance.

6

CONCLUSIONS

The objective of this report has been to provide an overview of the c-store industry and its energy use. The level of interest in, and opportunities for, improving c-store energy efficiency were also assessed through telephone contacts with c-store companies, design firms, and equipment manufacturers.

While energy use varies with store size, age, and location, an annual electric use of 100 kWh/sq.ft. has been estimated. With 84,500 c-stores in the United States, this translates to 19.2 billion kWh used annually.

Typical annual utility costs range from $8.75 to $12 per sq.ft. and represent approximately 14% of a store's direct operating costs. A 25% reduction in utility costs could improve a store's return-on-investment from 9 to 10%.

Although utility costs may not be highest on the c-store companies' list of priorities, efficient use of energy is recognized as a means to save money and improve profitability, a goal of each c-store. Several c-store companies are already using energy efficient lighting systems and are considering other alternatives for saving energy. Refrigeration and antisweat heater controls appear to be areas where significant gains can be made. An evaluation of R-22 or alternative refrigerants would also be valuable to the industry.

C-store companies, as well as equipment manufacturers, expressed interest in working with EPRI on a project to demonstrate methods for reducing energy use. This positive industry response suggests that additional research culminating with a demonstration project is warranted.

7

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A

CASEY'S GENERAL STORE

Study conducted by: Iowa Power, Sioux City, Iowa

Energy Saving Measures

Energy Cost Reduction Opportunities	Fuel Savings	Dollar Savings	Implementation Costs	Payback (Yrs)
Upgrade Fluorescent Lighting	11,874 KWH	$367	$2,195	4.9
Replace Designated Incandescent Lighting with Fluorescent	1,807 KWH	$56	$171	2.8
Install Energy Efficient Lamps	701 KWH	$22	$83	3.8
Raise Air Conditioning Temperature Setpoint	1,785 KWH	$55	$0	0.0
Lower Heating Temperature	1,250 KWH	$39	$0	0.0
Implement Temperature Setback	4,521 KWH	$143	$195	1.4
Install Roof/Ceiling Insulation	1,539 KWH	$48	$522	10.9
Maintain Air Conditioning Equipment	509 KWH	$16	$75	0.9
Reduce Water Temperatures	677 KWH	$21	$0	0.0
Reduce Excessive Hot Water Consumption	1,140 KWH	$35	$3	0.1
Install Tank Insulation	513 KWH	$16	$0	0.0
Install Destratification Fans	1.403 KWH	$43	see specific measure	see specific measure
Improve Refrigeration Maintenance	354 KWH	$11	see specific measure	see specific measure
Install Refrigeration Case Barriers	1,225 KWH	$38	see specific measure	see specific measure
Implement Cooking Improvements	3,428 KWH	$106	see specific measure	see specific measure

Figure 1-1: Savings Summary

2. CHAPTER TWO—FACILITY AND ENERGY PROFILE

2.1 ENERGY USE ANALYSIS

In order to properly evaluate opportunities for conserving energy, it is first necessary to analyze current energy usage and costs. The resulting energy profile serves as a basis for indentifying and quantifying savings opportunities.

A summary of energy usage and costs appears in Figure 2-1. Calculated at current rates, rather than historical rates from your past billing, annual energy costs for the facility total $7,240. The fuel is used as shown in Figure 2-3. This graph allows us to identify usage patterns in your facility.

Translating your facility's fuel consumption into energy usage and cost per square foot of building gives an indication of relative energy efficiency. The normalized energy usage for Casey's General Store is 335.667 BTUs per square foot.

2.2 COST OF ENERGY

The per unit cost of energy is an important factor in an energy conservation study. The two types of fuel pricing generally availabale are declining block pricing and flat rate.

The declining block price structure is designed so that as more units of fuel are purchased, the cost per unit decreases. The incremental cost of energy is the price of the last unit of energy used. Savings calculations are generally made applying incremental costs whenever this price structure is used. Composite cost is an average of all the fuel price blocks.

The flat rate structure is a straight price per unit of fuel. That is, the composite, or average, fuel costs and the incremental fuel cost are the same in a flat rate structure. Incremental and composite fuel costs are shown in Figure 2-2.

Annual Energy Costs and Usage

Source	Annual Usage	Unit	Annual Cost	$ Per Sq.Ft.	% of Cost	Energy (MMBTU)	MBTU per SqFt.	% of Energy
Electricity	177,029	KWH	$7,240	$4.02	100.0	604	335.7	100.0
Total			$7,240	44.02	100.0	604	335.7	100.0

(floor space used in analysis: 1,800 square feet)

Common Energy Conversion Factors

Electricity:	3.413 MBTU/KWH	**Natural gas:**	100.0 MBTU/Therm
Fuel Oil:	138.7 MBTU/Gal	**Propane:**	92.0 MBTU/Gal
Coal:	27,000 MBTU/Ton		

1 MBTU = 1,000 BTU 1 MMBTU = 1,000,000 BTU

Figure 2-1: Fuel Consumption

Energy Costs Per Unit

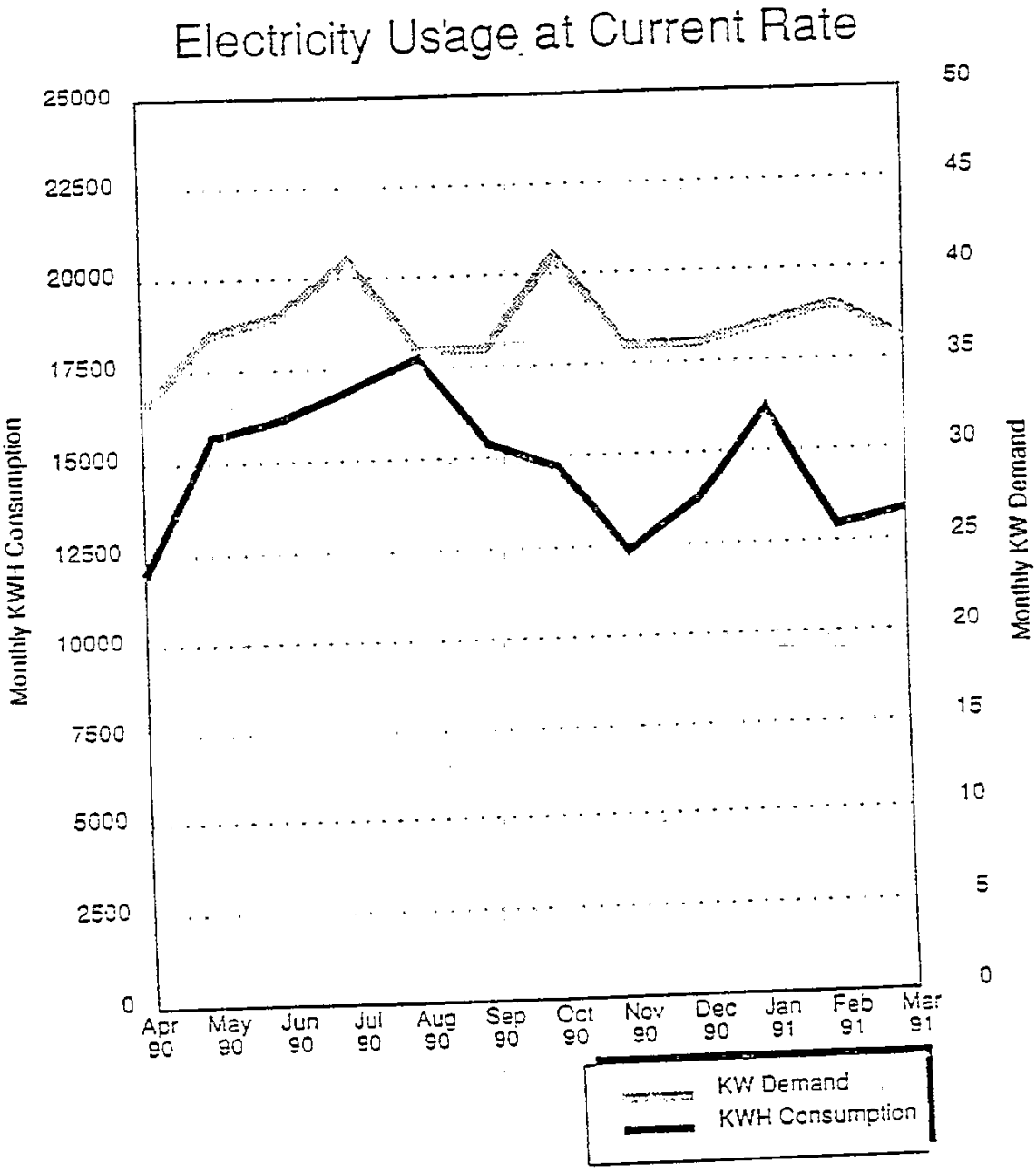
Fuel	Units	Incremental Costs	Cost Per Unit	Projected Price Rise (%)
Electricity	KWH KW (Demand)	0.0309 0.0000	0.0409	2.00

Fuel price rises include 0.0% annual inflation.

Figure 2-2: Cost of Energy

Electricity

Electricity is supplied to the facility at an average cost of 0.0409 per kilowatt hour while the incremental cost per KWH is 0.0309. The monthly incremental cost per kilowatt of demand used is $0.00. The incremental electrical costs which show the true cost of the last unit of electricity purchased, are applied in each of the energy savings calculations to provide an accurate assessment of cost savings. Figure 2-4 depicts electricity energy by end use.



Total Annual Electricity Usage	177,029 KWH
Total Annual Cost	$7,240
Average Cost	$0.0409

Figure 2-3: Electricity Usage at Current Rate

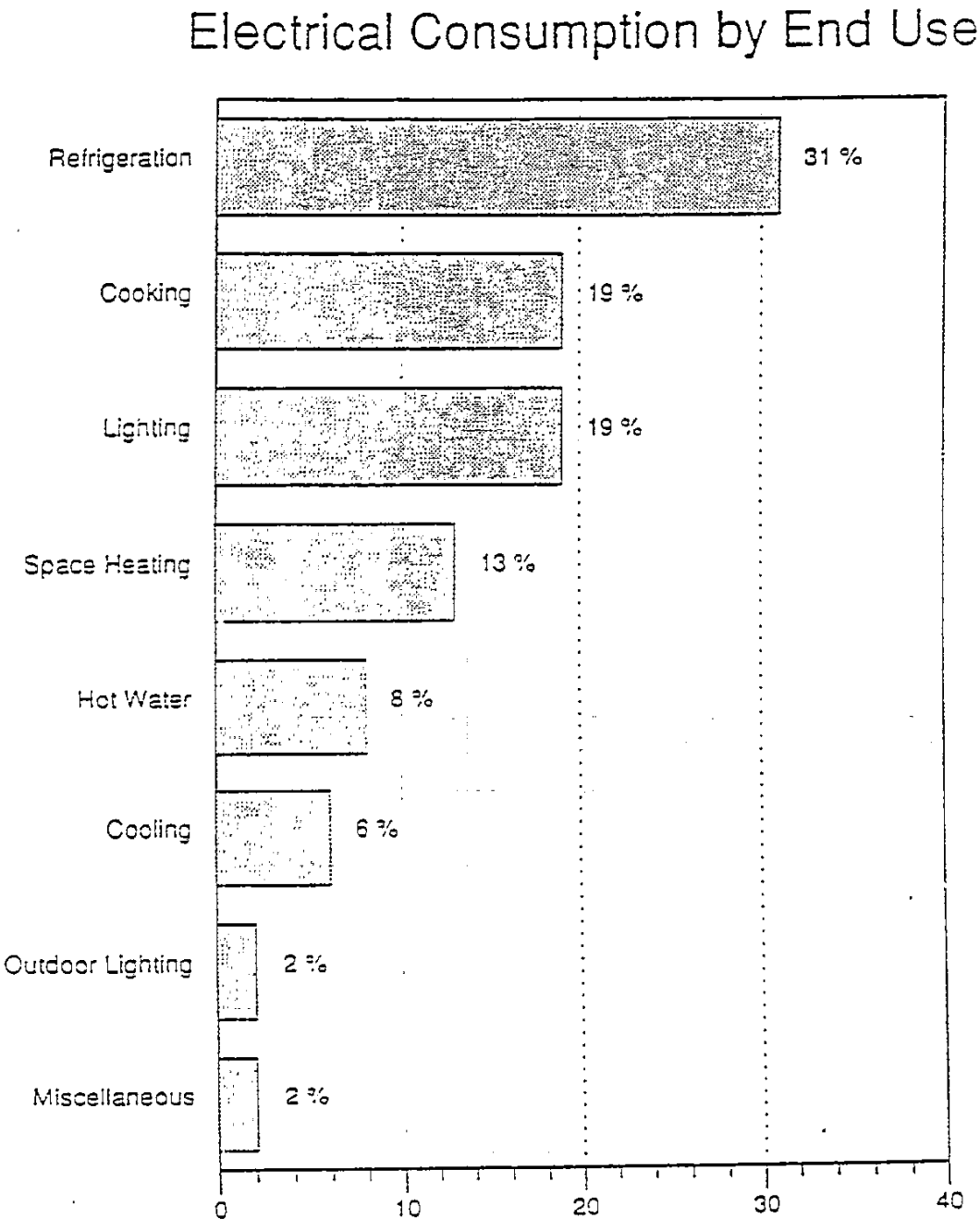


Figure 2-4: Electrical Consumption by End Use

B

PG&E -- 9 STORES

Study Conducted by: Pacific Gas & Electric

Of the 10 sample food retail stores, 9 are small convenience and liquor stores and 1 is a supermarket. Food retail stores are unique in that a large number of sites operate 24 hours per day, resulting in a relatively small variation in load throughout the day.

Refrigeration is the dominant load and is relatively flat, as shown in **Figure 8**. While the overall load profile has no major peak, there is a small increase in overall load in the early morning hours due to External and Cooking loads, and an increase in the evening due to a peak in External loads.

Figure 9 shows how annual end-use energy intensities (kWh/SqFt) vary across in the sample. Each dot represents a particular end use at an individual site. Refrigeration, which has the highest intensity values, also shows the greatest variation, ranging from approximately 10 to 60 kWh/sq.ft.

Refrigeration accounts for over half of total annual electric energy consumption, as seen in **Figure 10**. Refrigeration equipment contributes to space cooling, accounting for the relative smallness of the HVAC component.

FIGURE 8: AVERAGE WEEKDAY LOAD SHAPE WITH END-USE CONSUMPTION

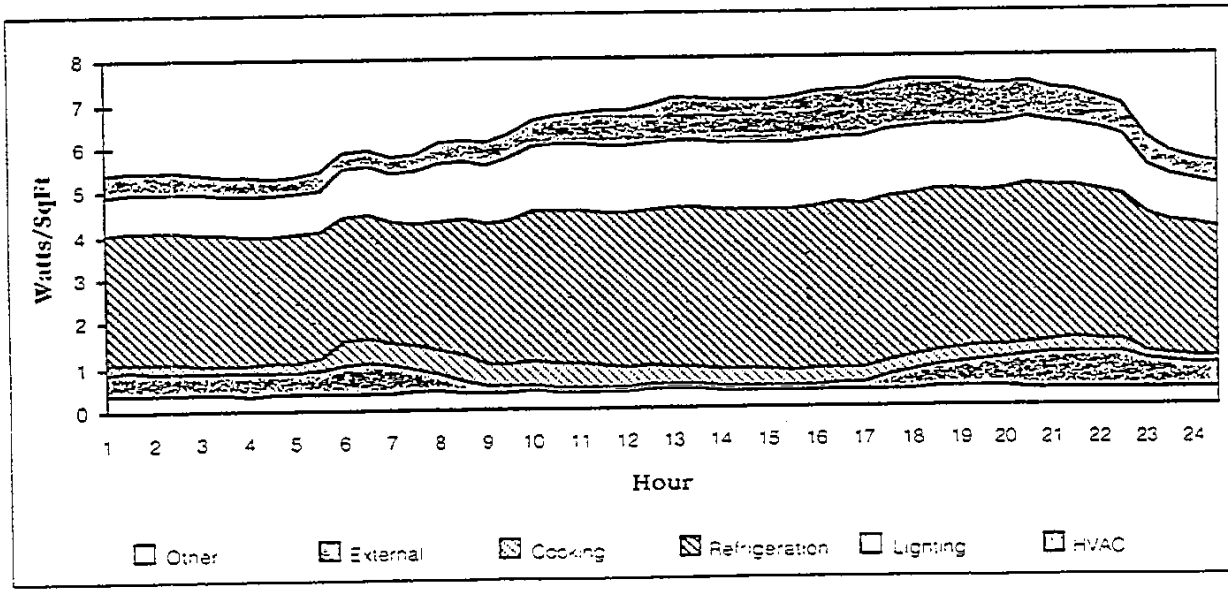


FIGURE 9: ANNUAL END-USE ENERGY INTENSITIES FOR INDIVIDUAL SITES

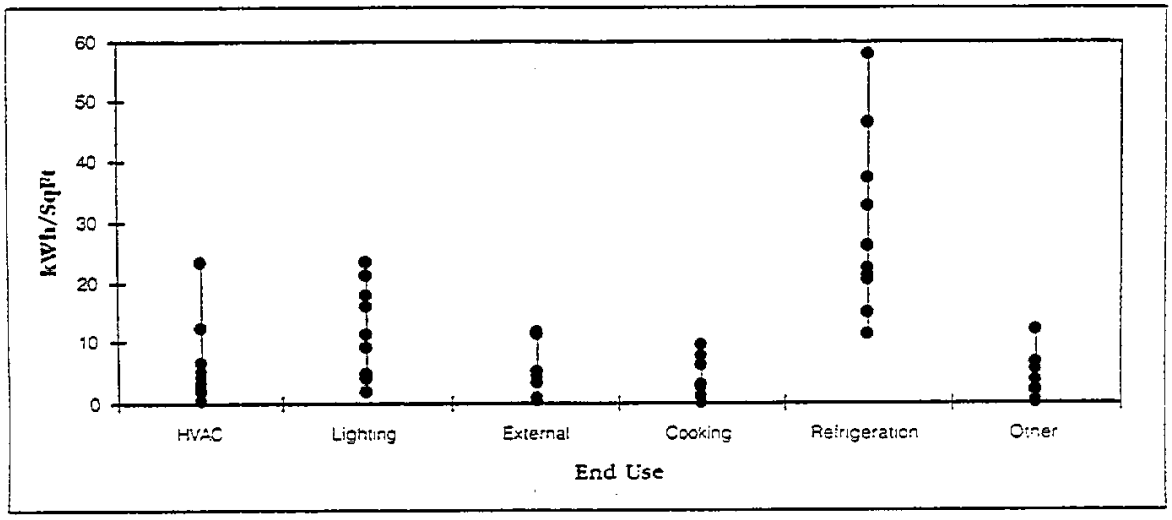
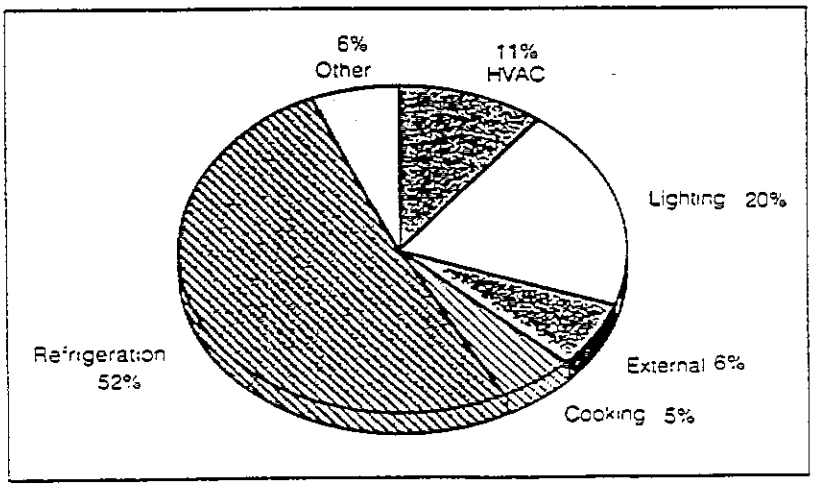


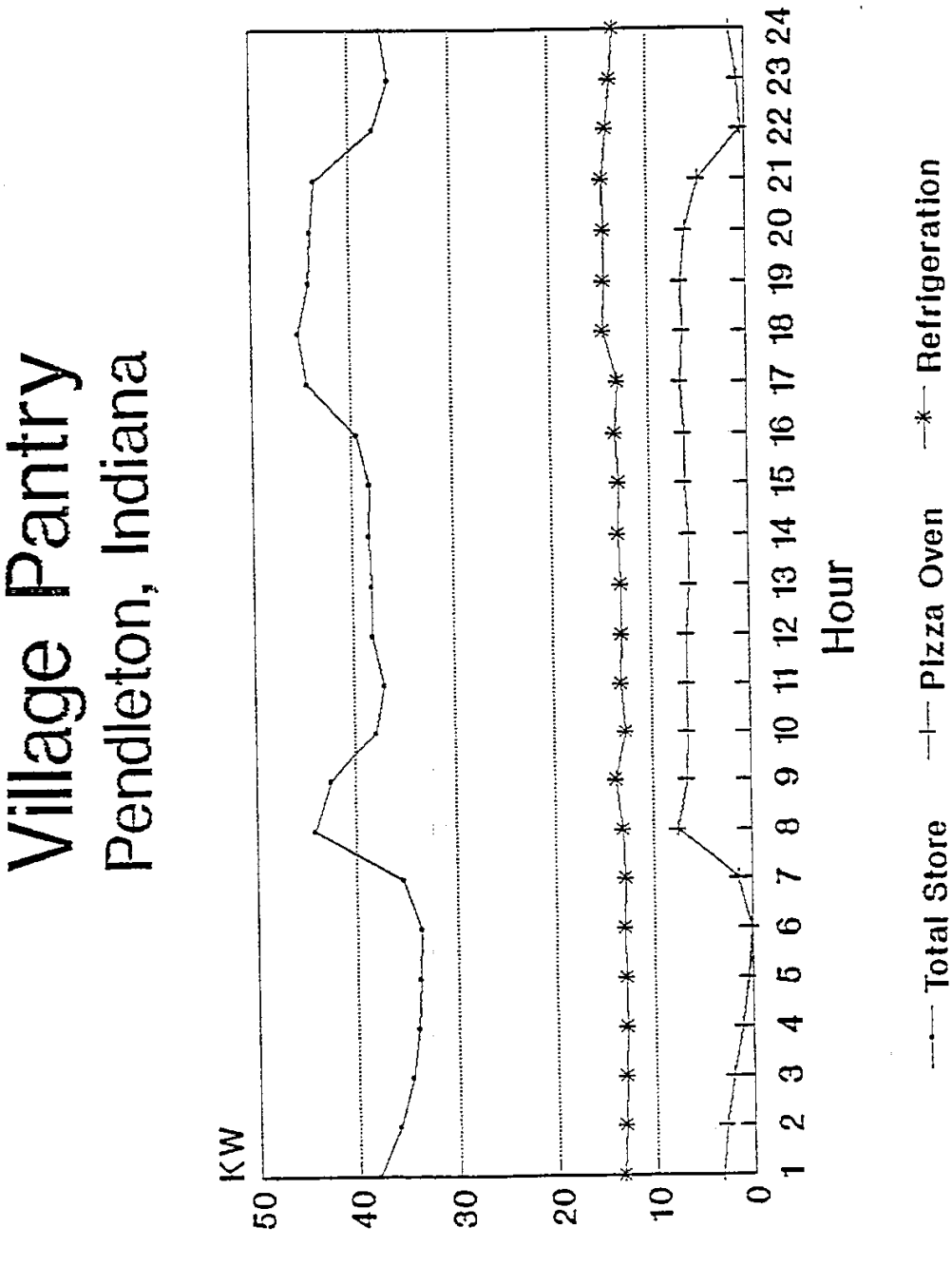
FIGURE 10: ANNUAL ELECTRIC ENERGY SHARES

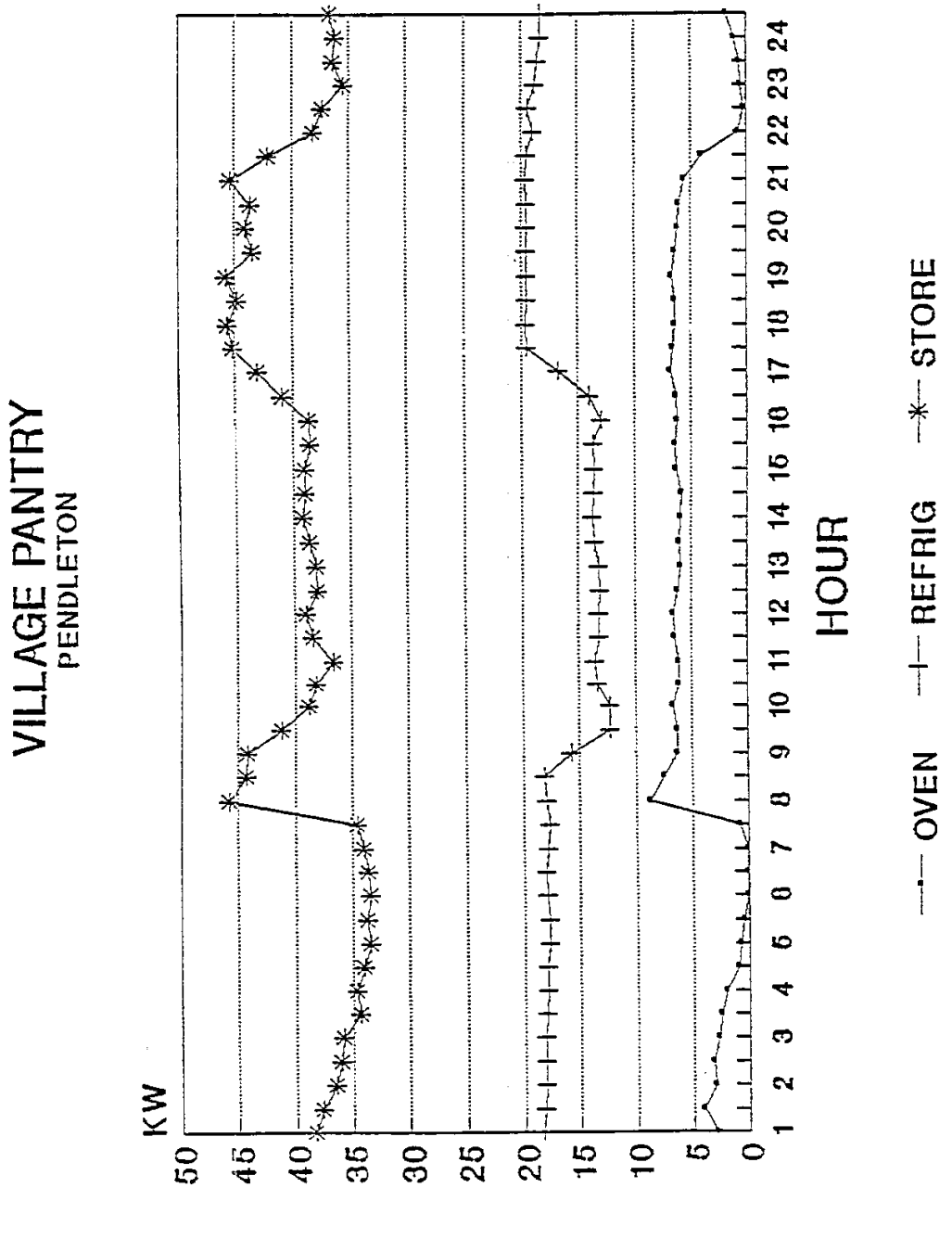


C

VILLAGE PANTRY

STUDY CONDUCTED BY: PSI Energy, Plainfield, Indiana

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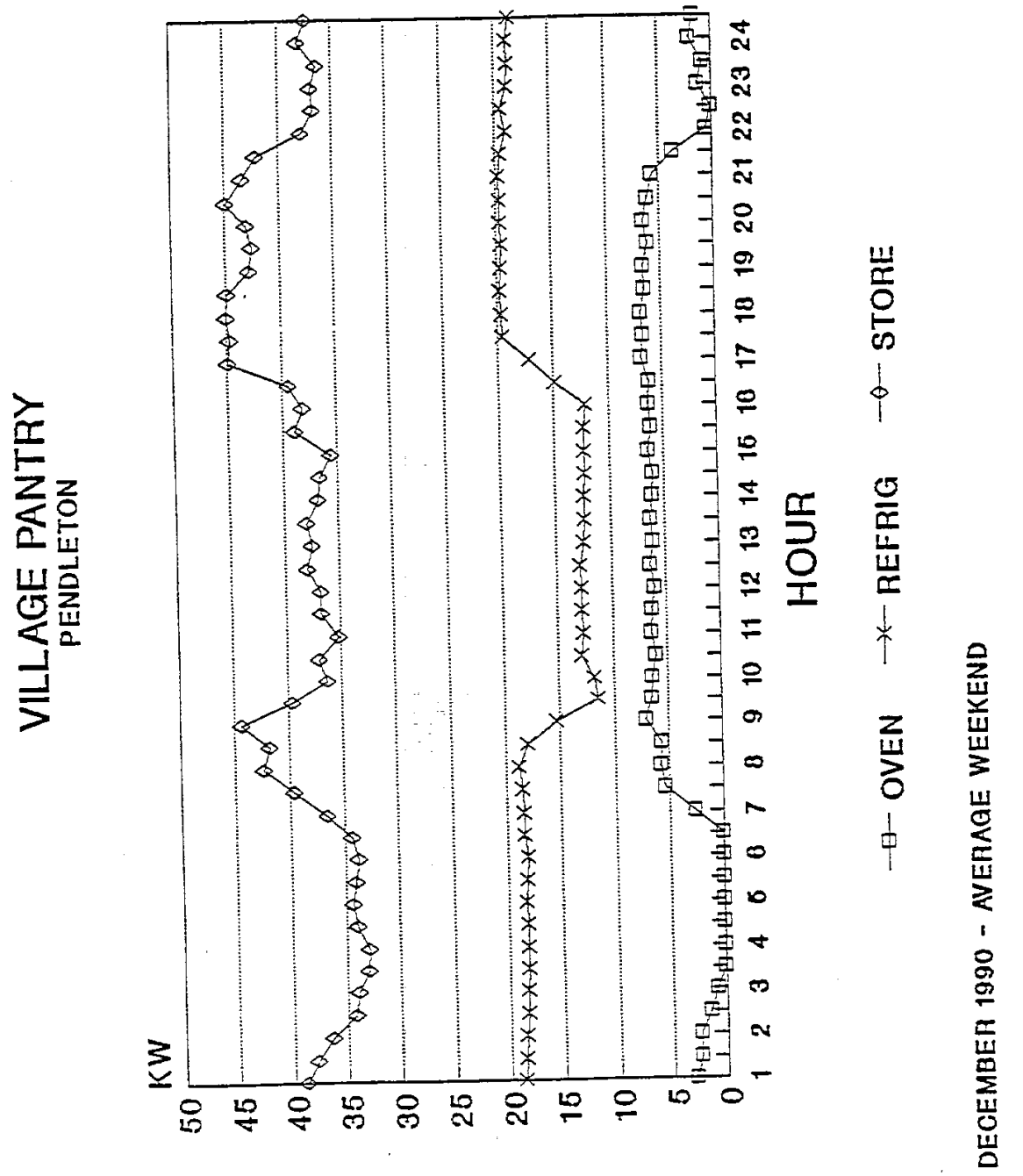
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DECEMBER 1990 - AVERAGE WEEKEND