A small-business guide

Convenience and Grocery Stores

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REPORT SUMMARY

Many of the challenges faced by small business owners can be addressed through efficient use of electric technology. Each volume in the Small Business Guide describes the current state of a business type and details new or alternative electric equipment that can help it meet its characteristic problems.

Background

Members of the Small-business community historically have had little contact with their energy providers. These guides were developed to facilitate communities.

Objective

To provide utility personnel and business owners and operators with information on the key electrotechnologies that can help these businesses complete effectively.

Approach

The project team researched small business energy, productivity, and environmental concerns and the electrotechnologies that can meet these needs. Telephone surveys, published reports, directories, buyers guides, and technical journals provided information on technology availability, suppliers, information sources and trade associations.

Results

The Small-Business Guide series covers a range of industries:

Volume 1: Wholesale Bakeries

Volume 2: Auto Body Shops

Volume 3: Lodging

Volume 4: Medical Clinics

Volume 5: Drycleaners and Launderers

Volume 6: Metal Finishers

Volume 7: Shopping Centers

Volume 8: Convenience and Grocery Stores

Each guide is based on extensive and ongoing research and contains the latest information available at the time of publication. The guides have been organized as a reference document for use on an as-needed basis. Section tabs are included to facilitate quick access to topics of interest; and each volume concludes with lists of equipment suppliers, EPRI information resources, and organizations.

EPRI Perspective

The EPRI Small Business target is dedicated to research, development, and dissemination of information on electrotechnologies that address the energy, productivity, and environmental concerns of small business owners and operators. Future volumes in the Small Business series will cover

- Printers
- Office Buildings
- Electronics
- Apparel manufacturers
- Photofinishers
- Plastic products
- Wood preservers
- Wood furniture.

TR-106676, Volumes 1- 8
Interest Categories

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Commercial appliances

Product and Service design

Marketing

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Wayne Krill manages the Small Businesses Target at EPRI and directed development of the *Guide.*

ABOUT THIS GUIDE

Members of the small-business community historically have had little contact with their energy providers. This guide was developed to facilitate communication between electric utilities and the convenience stores and grocery stores in their communities.

The *Convenience and Grocery Stores* guide is intended to familiarize readers with the business of food retail operations by describing different segments of the industry and summarizing the industry's key issues and challenges. It focuses on delineating how electric equipment can address the needs and interests of convenience and grocery store owners and operators.

This business guide is one of a series of publications about small businesses produced by EPRI. The *Convenience and Grocery Stores* guide is based on extensive and ongoing research and contains the latest information available at the time of publication. Nevertheless, it is a work in progress, rather than a definitive and final document. The information and resources presented offer the reader a solid base from which to develop electricity-based solutions to energy and business needs.

This document was organized as a reference guide for use on an as-needed basis. Section tabs are included to facilitate quick access to topics of interest; icons representing energy end uses are also provided to help with locating complete information on electrotechnology solutions.

During the 1990s, the number of stores selling food has fallen, and revenues from food sales have risen. For store owners and operators, the meaning is clear: the potentials for any given store are great, but each store must fight for a secure place in the market.

Most of the stores failing in this competition are "superettes" or small supermarkets; they are the largest food retail segment but lag far behind in sales. As these stores have been supplanted by large supermarkets and nontraditional food retailers, convenience stores have taken on greater importance, becoming the neighborhood resource for basic foodstuffs and perishables. Yet there is stiff competition among these small businesses as well, as convenience stores redefine themselves in sizes ranging from "mini" to "hyper" in a retail segment that some experts say is already saturated.

In 1993, grocery stores—small and large supermarkets and convenience stores—generated more than $361 billion in sales. Nontraditional food retailers, such as buyer's clubs and wholesale outlets, accounted for 7% of all product volume sold; by 1997, these outlets are expected to capture another 4% of the market. The owners of small supermarkets and convenience stores are intent on finding strategies to retain a loyal customer base and are mounting competitive countermeasures. Grocery stores are offering generic brands, wholesale pricing, and additional customer services, as well as using advanced labor- and time-saving technologies. Convenience stores are expanding their inventories selectively, with attention to competitive price.

For both types of operations, the imperative is to whittle costs—for labor, insurance, and energy—and expand revenues. The accompanying table identifies specific electrotechnologies that can help grocery and convenience stores minimize operating costs, attract customers, and maintain a cadre of productive employees. These electrotechnologies and other high-efficiency electric technologies are described in detail in the *Convenience and Grocery Stores* guide (TR-106676-V8), copies of which are available from the EPRI Distribution Center. To order this publication or other guides in the series, call the Center at (510) 934-4212.

Electrotechnologies for Convenience and Grocery Stores

	Energy-Efficient Outdoor Lighting	Foodservice Equipment	Purified-Water Vending Machines
Description	Six types of lighting technologies are available; each offers different characteristics in wattage, brightness, light tone, efficiency, and life span; they can be combined to meet site-specific needs.	A large variety of energy-efficient electric cooking equipment is available that is smaller, lighter, cleaner, cooler, more versatile, and often less expensive than gas equivalents.	The new purified-water vending machines use granular activated carbon, reverse osmosis, and/or ultraviolet disinfection technology to kill microorganisms and otherwise sterilize water for drinking.
Convenience and/or Grocery Store Need	Lighting improves the visibility and attractiveness of a facility, reduces the potential for crime, and increases shopper and employee safety.	Convenience and grocery store owners and operators are seeking ways to attract more customers and to entice customers to spend more of their food dollars at their stores.	The public is increasingly concerned about water quality; vending machines offer stores an opportunity to participate more directly in the growing market for high-quality drinking water.
Application	Signs on or near the building; general lighting in parking lots, walkways, delivery areas; facade and landscape lighting.	The FlashBake oven, induction cooktop, combination oven-steamer, and solid-state fryer offer stores efficient, versatile equipment for food preparation and quick-serve reheating of foods.	These vending machines are appropriate for installation at any convenience or grocery store; they can be installed either inside or outside the facility, depending on the climate.
Benefits	Increased public perception of goodwill, success, and quality from general and facade lighting; reduced accidents, injuries, and crime from area lighting.	Electric foodservice equipment is easy to install, simple to operate, and cool to work near, enabling stores to expand operations cost-effectively with minimal employee training.	Purified-water vending machines give shoppers access to high-quality drinking water at lower cost than bottled water, and add to store revenues.
Cost	Systems are custom-designed to meet a facility's needs and budget.	The 1996 list price for the FlashBake oven is $4400; the induction cooktop, $6700; the combination oven-steamer, $18,600; and the solid-state fryer, $4100. The actual cost is typically less than the list price.	Water vending machines producing 75–3000 gallons per day cost $2700–$12,000 to purchase, and generally require 0.6–3.6 kW of electricity to operate.

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1

INTRODUCTION TO CONVENIENCE AND GROCERY STORES

Until the 1930s, people purchased food from small neighborhood stores, often family-owned businesses where patrons were served on a first-name basis. When supermarkets—large, self-serve grocery stores—entered the marketplace in the 1930s, they had an immediate advantage: through economies of scale, they could charge customers less and still earn a greater profit. As supermarkets prospered, small grocery stores went out of business or were bought out by their supermarket competitors. In their wake, neighborhood convenience stores sprang up. They offered customers easy access to a limited number of perishables and staples—such as bread, milk, soda, and beer—in between routine trips to grocery stores. Open 24 hours a day, convenience stores also had goods available when grocery stores were closed.

Business Overview

Today, both convenience and grocery stores are facing intense competition—from other convenience and grocery stores and from nontraditional food retailers, such as discount food chains and wholesale clubs. The battle for customers is fueled by changes in both demographics and consumer buying habits. In response, grocery stores are adopting a raft of competitive countermeasures, such as offering generic brands, wholesale pricing, and more consumer services, as well as utilizing advanced labor-saving technologies, such as quick-response systems. At the same time, convenience stores are adding more products to their inventories at increasingly competitive prices. Both convenience and grocery stores are seeking ways to attract new customers, reduce operating costs, and retain their most productive employees.

The U.S. Department of Agriculture (USDA) uses the term "grocery stores" to refer to three types of establishments.

- Supermarket: "A grocery store . . . providing a full range of departments and having at least $2.5 million in annual sales in 1985 dollars."
- Superette: "A grocery store selling a wide variety of food and nonfood products with annual sales below $2.5 million (1985 dollars)."

- Convenience Store: "A small grocery store selling a limited variety of food and nonfood products, typically open extended hours."

Table 1
Profile of Grocery Store Establishments

Segment	No. of Establishments (in 1000s)				Sales ($ millions)			
	1990	1991	1992	1993	1990	1991	1992	1993
Supermarket	23.8	24.9	24.6	24.5	260.1	268.9	274.3	281.0
Convenience Store	51.7	50.7	49.9	49.5	50.8	49.8	48.5	46.5
Superette	94.6	92.4	91.4	89.8	32.0	36.9	34.1	33.9
TOTAL (SIC 5411)	170.1	168.0	165.9	163.8	342.9	355.6	356.6	361.4

Source: U.S. Department of Agriculture, Economic Research Service, *Food Marketing Review,* various years.

All of these establishments are classified as grocery stores within Standard Industrial Classification (SIC) 5411. This guide, however, focuses primarily on the smaller grocery stores—convenience stores and superettes (referred to as "small supermarkets").

Due to differing definitions of "convenience store," estimates of the size of the grocery store population vary widely. The USDA estimates that there were 163,800 grocery store establishments in the United States in 1993, employing 2.7 million people and generating more than $361 billion in sales (see Table 1). Superettes make up the largest portion of the industry in terms of the number of establishments, but contribute the smallest portion to total industry sales. Approximately 87% of all grocery stores have fewer than 50 employees, and about 95% have fewer than 100 employees (see Table 2).

Convenience Stores

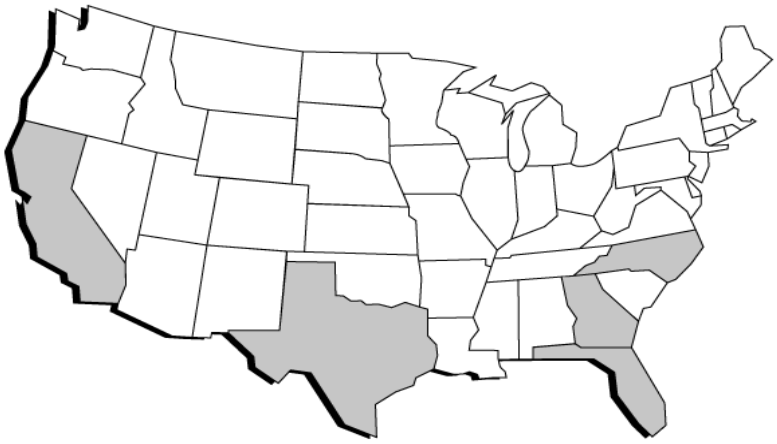
While convenience stores (c-stores) can be found in all areas of the country, they occur in greatest numbers in the South and West. According to a 1995 survey by the National Association of Convenience Stores (NACS), Texas has the largest number of c-store establishments (10,625), representing about 11% of the 93,200 establishments in the survey. Florida and California follow, with 7186 and 6394 c-stores, respectively. Rounding out the top five states are North Carolina (3868) and Georgia (3765). States with the smallest number of c-stores include Alaska (84) and Vermont (158).

Table 2
Distribution of Grocery Stores by Size (1993)

Size	No. of Establishments	Percent of Total
Small (0–49 employees)	115,822	87
Medium (50–99 employees)	10,471	8
Large (100 + employees)	6,742	5
TOTAL (SIC 5411)	133,035	100

Source: U.S. Department of Commerce, Bureau of the Census, *County Business Patterns 1993—United States*, CBP-93-1, 1996.

States	Convenience Stores
TX	10,625
FL	7,186
CA	6,394
NC	3,868
GA	3,765



Source: National Association of Convenience Stores.

Figure 1
Top Five States for Convenience Stores

A typical c-store ranges in size from 800 to 5000 square feet and usually has a small parking lot with four or five parking spaces. The NACS has defined five primary formats for c-stores.

Mini (800–1200 ft^2): The mini c-store typically is attached to a gasoline station and is open 18–24 hours a day. It usually provides a small selection of grocery items and has little or no provision for foodservice. While operations are simple and require limited employee training and supervision, profitability is highly dependent upon volatile gasoline margins.

Limited-Selection (1500–2500 ft^2): 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. The limited-selection c-store usually has a simple foodservice operation, providing foods such as hot dogs or popcorn, and is often affiliated with an oil company.

Traditional (2400–2500 ft^2): The traditional c-store frequently sells gasoline and carries a varied product mix including dairy, bakery, snack food, beverage, nonperishable grocery, health and beauty aids, fresh and/or frozen meat, and produce items. It may also have video games, a bank machine, and/or a microwave. Many traditional c-stores are open 24 hours a day, and have 6–12 parking spaces. Most of the original c-stores fall into this category and are part of c-store chains, such as "7-Eleven" and "Stop N' Go."

Expanded (2800–3600 ft^2): A growing segment of the market is the expanded c-store establishment, which has more floor space—to accommodate additional shelves for groceries and/or a more significant fast-food operation that includes seating. These stores attract a broader range of customers than the traditional c-stores. Many c-store chains see incorporating fast-food services as essential, due to increased competition from oil companies in the smaller c-store format.

Hyper (4000–5000 ft^2): Very large ("hyper") c-stores offer an array of products and services arranged in departments—a bakery, a sit-down restaurant area, a pharmacy, etc. Many of these stores sell gasoline and serve in some locales as "mini truck stops."

There are two types of operators within the c-store industry: "traditional operators" and "petroleum marketers." The distinction is not whether a store sells gasoline, but in the store's origin. This guide focuses on the grocery rather than the gasoline component of these stores. It is important to note, however, that nearly three-quarters of all c-stores sell motor fuels and that gasoline sales contribute significantly to industry revenues.

While the c-store industry had 1% fewer establishments in 1993 than in 1987, retail sales increased by nearly 30% in that six-year period. This sales increase is due mostly to a gain in gasoline and merchandise sales by petroleum marketers; in contrast, sales by traditional operators have fallen. In response, traditional operators have been aggressively shutting down poorly performing stores. The c-stores that remain show higher average merchandise sales. However, petroleum marketers have been moving into new markets and building new stores.

According to the NACS, despite some industry consolidation, many chains are planning expansions and upgrading existing stores. Much of this expansion is likely to include additional foodservice operations; for example, the new "co-branded convenience store" is a store that includes a franchise fast-food operation.

Types of Convenience Store Operators

Traditional Operators

Traditional operators are companies that began with the purpose of operating c-stores, although 80% now offer gasoline as well. Examples include Southland Corporation (7-Eleven) and Circle K Stores. Approximately 60% of c-stores in the United States and Canada are traditional operators.

Petroleum Marketers

Petroleum marketers have their roots in petroleum product distribution. In this case, c-stores were often added to an original gas station business. The petroleum marketer category includes stores run by major oil companies, oil jobbers who entered the gasoline retail business, and former gas-only retailers who later added a c-store; examples include BP, Shell, and Mobil. Approximately 40% of c-stores are operated by petroleum marketers.

While both operators utilize all five c-store formats, stores owned by petroleum marketers are typically smaller, consistent with their focus on gasoline sales.

Small Supermarkets

While supermarkets are located in virtually every area of the country, their number in any particular location depends on the size of the local population. As a result, the states with the most supermarket establishments are also the states with the largest populations. In 1992, California led the list, having more than 7250 supermarkets, followed by Texas (4770), Florida (3224), Michigan (2999), and Illinois (2940) (see Figure 2).

States	Supermarkets
CA	7251
TX	4770
FL	3224
MI	2999
IL	2940

Source: U.S. Department of Commerce, Bureau of the Census, *Census of Retail Trade, 1992,* CD-EC92-1H, May 1996.

Figure 2
Top Five States for Small Supermakets

Supermarkets developed in the 1930s in response to the demand for lower-priced goods during the Depression. By having customers select and handle the goods they wanted to purchase and making use of economies of scale, supermarkets could charge less. In addition, the growing use of cars and refrigeration nurtured a trend toward bulk purchasing, a consumer interest more easily met by the larger, well-stocked supermarkets. The number and size of food stores increased throughout the 1930s and 1940s, compelling significant competition. As stores incurred larger bills for advertising and promotional spending, their profit margins fell—with dramatic results: The number of food stores declined from 390,000 in 1948 to 288,000 in 1954.

In the 1960s, stores began to focus on discount pricing and cost cutting, rather than promotional activities, to attract customers and increase profit margins. Many supermarkets also expanded, offering more general merchandise and pharmaceuticals, delicatessen food, and baked goods. “One-stop-shopping” superstores that stocked health and beauty items and household supplies evolved in the early 1970s in response to changes in the culture, such as women in the workforce and diminishing “leisure” time. Although these superstores resulted in increased sales for the industry as a whole, they led to a further decline in the total number of grocery stores.

The supermarket industry as a whole sustained losses during the recession of the early 1990s. Growth is expected to be modest in the mid-1990s, due to a slow economic recovery and increasing competition. Sales are forecast to grow 2–4% annually through 1997.

While the largest share of grocery store (SIC 5411) sales are expected to remain with supermarkets, competition within the supermarket business and from alternative grocery retailers is projected to increase throughout the remainder of the 1990s. Continued pricing competition from warehouse buyer's clubs such as "Price-Costco" and "BJ's Warehouse" will hold growth in supermarket sales in check.

In 1992, nontraditional food sales outlets—such as buyer's clubs and wholesale outlets—accounted for 7% of all product volume sold by food stores and 1% of all competing food store units. By 1997, nontraditional outlets are expected to have captured the market for more than 11% of all product volume sold and to represent 1.5% of all competing units.

Warehouse buyer's clubs have lower prices for merchandise and lower operating expenses: their operating expenses are only 7.5% of sales, compared to 22% for supermarkets. As a result, supermarkets are endeavoring to lower their operating costs as well as to cut prices. Many supermarkets are also moving toward developing lower-cost "house" brands for common items such as soda, frozen vegetables, and dairy products. Others are targeting a niche market by emphasizing premium, gourmet, or organic foods. Consultants have advised supermarkets and small grocery stores to concentrate on building customer loyalty, as it will be difficult to compete with alternative grocery retailers on price alone. One suggestion is to target a local market. For example, smaller grocery stores in Los Angeles are catering to the local Latino population by specializing in produce from South America, fresh tortillas, and other hard-to-find "traditional" foods.

Energy Use

According to U.S. Department of Energy (DOE) data on the 130,000 buildings classified as "food sales"—a category that includes supermarkets and convenience stores as well as specialty stores such as delicatessens and retail bakeries—the food sales industry consumed 137 trillion Btu of energy in 1992. More than 82% of this energy was electric, equaling an electricity consumption of 33 billion kWh. The remaining 18% (24 trillion Btu) was natural gas.

Convenience Stores

Most c-stores are open 18–24 hours a day and use a relatively constant amount of electricity throughout the day. However, the number of c-stores operating around the clock has decreased over the past five years. The factors involved in this change include restrictive local legislation, security concerns, and, for many operators, the greater relative cost of doing business during the third shift—the midnight to 8:00 A.M. period when sales often do not meet overhead expenses.

An NACS study estimates that the total direct operating expense for a 2400-square foot traditional c-store is $149,000 per year, although actual expenses differ with location. Utility expenses represent 14% of the total, or $1740 per month. Only labor (44%) and insurance/licensing costs (30%) represent larger portions of direct operating expenses. A telephone survey conducted for EPRI revealed that c-stores annually spend $8.75–$12.00 per square foot on electricity, depending on store format. Assuming an electricity price of $0.09 per kWh, this suggests electricity use of 97–133 kWh per square foot per year.

Refrigeration equipment accounts for most of the electricity use (51%); 23% of refrigeration electricity use is for walk-in coolers (which use electricity for refrigeration, lighting, and anti-sweat heater controls), and 28% for other refrigeration. HVAC and lighting each account for another approximately 20% of electricity consumption. The remaining 10% of electricity is used in foodservice and by miscellaneous equipment (see Figure 3).

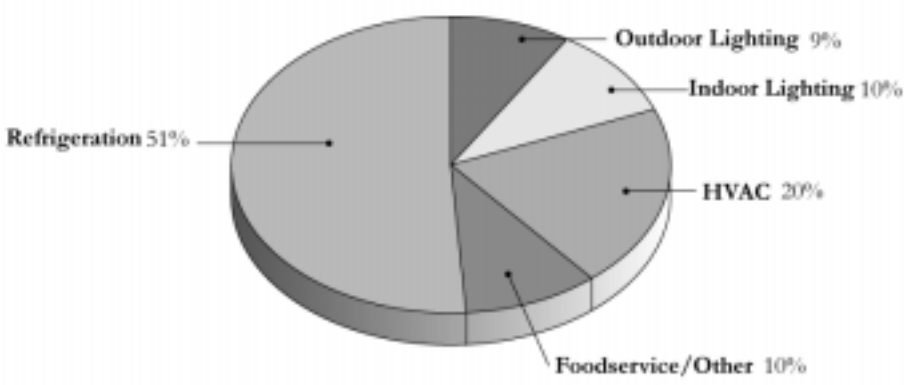


Figure 3
Typical Electricity Use in Convenience Stores

Although energy costs may not be high on a c-store owner's list of priorities, efficient use of energy is widely recognized as a means to save money and improve profitability. According to the NACS, electricity costs can be reduced by an estimated 25% through the use of energy-efficient lighting systems, refrigeration controls, and anti-sweat heater controls on display cases. This savings, in turn, can improve a store's overall profit. However, the general trend in c-stores is increased electricity use—particularly for foodservice, but for other plug loads as well. Remodeled stores frequently must upgrade electrical service in order to accommodate additional foodservice equipment, video game machines, automated teller machines (ATMs), and checkout scanning systems.

Small Supermarkets

Little variation in energy use from month to month is typical for any given supermarket. High internal loads from lighting, refrigeration display cases, and coolers outweigh weather-related loads (ventilation, building envelope, and infiltration). Also, energy use for heating/cooling is minimized since a large amount of energy is available from display case and cooler refrigeration. Typically, supermarket electricity use ramps up in the early morning (as a store gets ready for the day), peaks in the mid- to late-afternoon (the heaviest shopping hours), and tapers off after 8:00 P.M.; therefore, grocery store demand and electric peak load profiles match almost exactly.

The typical supermarket is open 105 hours a week (or 15 hours a day, for a store open seven days a week); approximately 18% are open 24 hours a day, seven days a week. Small supermarkets, those with floor space of 1000–5000 square feet, make up about 80% of the total supermarket population.

Supermarket electricity use depends on geographic location (i.e., climate), store design, and operating practices. Figure 4 illustrates the typical breakdown of electricity use in a supermarket. As in c-stores, refrigeration represents the largest percentage of total electricity use (50%). This electricity is used by compressors (30%), display cases (16%), and condenser fans (4%). Lighting accounts for 25% of electricity use—21% for indoor and 4% for outdoor. The remaining electricity use is for foodservice and other equipment (14%) and HVAC (11%). Compared to c-stores, supermarkets use more electricity for lighting and less for HVAC.

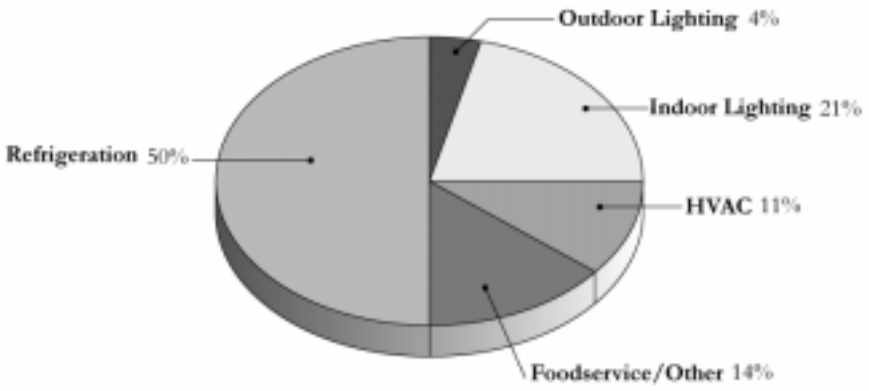


Figure 4
Typical Electricity Use in Small Supermarkets

According to the DOE, the electric intensity of all food sales buildings was 44 kWh per square foot in 1992. This figure is supported by an energy audit of 27 supermarkets conducted in 1994 by Reynolds, Smith, and Hills, Inc., and is higher than the electric intensity reported by the DOE for other commercial operations, such as foodservice (27 kWh/ft^2), healthcare (23 kWh/ft^2), and lodging (19 kWh/ft^2). It is lower, however, than that reported for c-stores, most likely because many c-stores are open 24 hours per day.

2

BUSINESS CHALLENGES AND NEEDS

Food retailers face the dual challenges of a competitive, yet slow-growing, market and changes in demographics and consumer buying habits. As a result, their primary concerns center around reducing operating costs, hiring and retaining good employees, and gaining and sustaining the interest of consumers.

Competition

Both c-stores and grocery stores exist in an environment of stiff competition. As smaller supermarkets continue to be replaced by larger supermarkets, the role of the c-store has grown—to meet consumer demand for a quick place to stop for a quart of milk or a loaf of bread. However, the c-store market itself seems to have reached saturation and is becoming increasingly competitive. Small c-store chains and individual stores are beginning to consolidate. Traditional c-store operators are downsizing and concentrating on improving existing stores by changing their product mix and enhancing customer service.

Small supermarkets face competition from both larger supermarkets and nontraditional food retail outlets such as warehouse clubs. Warehouse clubs have one key advantage: economy of scale. They purchase large volumes of products packaged in multipack or larger sizes, such that the cost per product unit is minimized. Coupled with a "no-frills" shopping environment, this allows warehouse clubs to offer low retail prices. On the downside, warehouse clubs stock a fairly limited variety of products/brands, are often inconveniently located, and force customers to purchase goods in large quantities that must then be stored at home.

Growth in the popularity of these stores indicates that many shoppers are willing to forgo convenience to obtain a lower price. In this increasingly price-sensitive and cost-conscious environment, supermarket owners and operators are focused more than ever on reducing operating costs, so that they have the flexibility to reduce retail prices to attract customers. Although not directly related to competition, industry sources also indicate that retaining good employees is a key concern.

Need

Reduce Operating Costs

Given the heightened competition—among c-stores, between c-stores and supermarkets, and between supermarkets and larger traditional and nontraditional food stores—all food retailers are focused on operating costs. Since profit margins are typically small (pretax profits are about 1% of sales for supermarkets and about 2.2% of sales for c-stores), even seemingly minor savings in operating costs can significantly affect the bottom line.

Labor represents the largest component of operating expenses. As a result, many supermarkets have moved toward the use of more sophisticated information technologies that can improve checkout, accounting, ordering, receiving, and scheduling efficiencies—while also reducing labor costs.

Energy costs, which can account for 3–10% of total operating cost, are also potentially significant. According to the Food Marketing Institute, the typical supermarket energy bill (1.2% of sales) is nearly equal to a store's pretax profit. Therefore, reductions in energy cost can significantly affect a supermarket's or c-store's bottom line.

Technology Solutions

A range of energy-efficient refrigeration technologies is available to help convenience and grocery store owners and operators reduce energy costs. Energy-efficient indoor and outdoor lighting can also reduce electricity use. Electric and desiccant dehumidification can reduce operating costs by improving the operating efficiency of refrigeration systems. Heat recovery and thermal energy storage, in some applications, represent additional opportunities to reduce HVAC-related energy costs.

See pages 3-3, 3-7, 3-10, 3-13

Need

Hire and Retain Good Employees

Both c-stores and supermarkets cite maintaining a staff of friendly, hardworking employees as one of their most important challenges. Long-term employees build valuable relationships with customers and are more efficient and productive than new employees. Stores that are able to retain a staff of quality employees have a competitive advantage over stores that cannot.

A number of factors, both tangible and intangible, contribute to any employee's decision to stay with a c-store or supermarket employer long-term, but a store can affect that decision by providing a comfortable, safe, working environment with appropriate indoor lighting levels, comfortable temperature and humidity levels, a well-lit parking lot, and a good security system. Electronic information technologies, such as bar-code scanning, can also indirectly improve the employer-employee relationship.

Technology Solutions

Energy-efficient indoor and outdoor lighting and electric foodservice equipment can have a positive impact on employee productivity by providing a more comfortable and safe work environment.

See pages 3-7, 3-13

Demographic Changes

One of the more significant demographic changes in the United States over the past years is the decline in the number of married-couple households. Because increasing numbers of people are living alone, or at least eating alone, retailers must market more prepared foods and "single-serving" products. In addition, since the 1970s–1980s when large numbers of women entered the workforce, there are now a larger number of dual-income families—consumers for whom overall convenience and a swift checkout process are essential.

Need

Meet Consumer Demands/Attract Customers

While most c-stores and small supermarkets sell similar basic food and nonfood items, a breadth of products and services, increased convenience, good overall appearance and atmosphere, and a safe environment can help bring new customers to a store, and promote a longer, more relaxed (and profitable) shopping experience.

Offer a Greater Variety of Products and Services. The trend in c-stores and small supermarkets is toward larger stores that offer more variety in product and service choices. For example, c-stores are expanding their services to offer check cashing, film processing, and drycleaning, as well as access to fast food, ATMs, copy and fax machines, and postal services. Supermarkets are adding many of these same services as well as pharmacy, bakery, and/or deli/cafe departments. This enhanced variety in products and services builds traffic, sales, and competitive advantage by increasing customers' reasons for stopping at a store and enabling food stores to expand revenues from nonfood sales.

Increase Convenience. In addition to a convenient store location, improving the speed of the checkout process can make a critical difference for customers who put a premium on getting in and out of a store as quickly as possible. Bar-code scanners and other types of quick-response systems are now common in supermarkets and gaining acceptance in c-stores. Experts estimate that over the next few years, supermarkets without bar-code scanning will be at a competitive disadvantage.

Improve Overall Appearance/Atmosphere of the Store. The overall appearance of a store, including a well-lit facade and parking lot, helps attract customers. A comfortable indoor atmosphere in which the temperature, humidity, and lighting levels are appropriate and pleasing has proven to increase the amount of time shoppers spend in a store, and overall sales as well.

Improve Safety and Security. Security is an important factor in attracting customers and retaining employees. It is a particularly important issue for c-stores, which are commonly open late at night. A c-store (or supermarket) on this schedule must use a security system that includes bright outdoor lighting, cameras, and alarms. This equipment helps customers and employees feel more comfortable in and around the store and can establish an environment that deters crime. A lack of security and lighting may put a store at a competitive disadvantage.

Technology Solutions

Energy-efficient indoor and outdoor lighting can improve the overall appearance and atmosphere of a store as well as enhance safety and security for shoppers and employees. Electric foodservice equipment can enable c-stores and supermarkets to offer additional food products, such as fresh-baked bread, pizza, and fast food. Purified-water vending machines give shoppers a convenient, lower-cost alternative to bottled water for obtaining high-quality drinking water.

See pages 3-7, 3-12, 3-13

Barriers to Technology Adoption

Although there is significant interest among many convenience and grocery store owners and operators in reducing operating costs by increasing energy efficiency, there are also a number of barriers to putting that interest into action. They include first cost and bad past experience with the reliability of new technologies.

First cost is often a c-store or supermarket owner's most important criterion when selecting a new piece of equipment. As a result, the relatively high first cost of many energy-efficient technologies discourages potential buyers. In addition, because equipment reliability is paramount in food sales, facility managers tend to stick with older, more well-known technologies rather than risk the use of a new, relatively

untested technology. This is especially true with regard to the refrigeration system; if a refrigeration system breaks down, a store risks spoiling its entire stock of perishables.

3

TECHNOLOGY SOLUTIONS

This section describes each of the technology solutions identified in the previous section. Each technology is summarized, linked by end-use application to a business need, and categorized as an "electrotechnology" or an "efficiency technology." Electrotechnologies are selected new or alternative electric equipment options. In many c-store and/or supermarket applications, the electrotechnologies can help reduce operating costs, retain quality employees, and/or meet consumer demands. Efficiency technologies are electric technologies that offer opportunities to decrease energy use but have little or no direct impact on operation. "Emerging" technologies are technologies not currently used in the industry but that have the potential to meet a business need.

"Partnering opportunities" are also discussed in this section; these are opportunities for a utility to conduct energy-related educational or other activities that might enhance grocery store operations. Each identified electrotechnology is more completely described in Section 4, Electrotechnology Profiles. Vendors of the electrotechnologies, sources of information on efficiency technologies, and trade associations are listed in Section 5, Resources.

In this section technologies are grouped and discussed by end use, beginning with "Refrigeration," the end use that represents the greatest percentage of total c-store and small supermarket electricity use. Table 3 summarizes the technology solutions.

Table 3
Technology Solutions to Convenience and Grocery Store Needs

			Business Needs		
End Use	**Solution Type**	**Technology Type**	**Reduce Operating Costs**	**Retain Good Employees**	**Attract Customers and Meet Demands**
Refrigeration	Efficiency Technology	Energy-Efficient Refrigeration Technologies	■		
HVAC/ Refrigeration	Partnering Opportunity	CFC Education			
Lighting	Efficiency Technology	Energy-Efficient Indoor Lighting	■	■	■
Lighting	Electrotechnology	Energy-Efficient Outdoor Lighting	■	■	■
HVAC	Efficiency Technology	High-Efficiency Electric Dehumidification	■		
HVAC	Efficiency Technology	Heat Recovery	■		
HVAC	Emerging Efficiency Technology	Thermal Energy Storage	■		
Foodservice and Other	Electrotechnology	Electric Foodservice Equipment		■	■
Foodservice and Other	Efficiency Technology	Desuperheater	■		
Foodservice and Other	Electrotechnology	Purified-Water Vending Machine			■

Refrigeration

Refrigeration is the key necessity in the food sales industry, used to protect and extend the freshness of perishable items such as meats, dairy products, and produce. These items represent 40–50% of a supermarket's total sales (somewhat less for a c-store) and are the primary products that bring customers into a store. Because refrigeration systems operate 24 hours a day and consume 50% of a store's electricity, improving

refrigeration energy efficiency is the quickest route to a reduction in the total energy bill.

In traditional and larger c-stores, the refrigeration system typically consists of walk-in coolers located at the back of the store. These coolers combine storage and display in one unit. Smaller stores use self-contained display units that can be moved from one location to another. Lighting and door anti-sweat heaters run continuously in both types of coolers and consume 16% of the electricity used for refrigeration.

Grocery stores typically contain walk-in coolers, refrigerated display cases, and freezers. While the mix of cases is site-specific, data collected by the DOE indicate that all food stores use refrigerated cases and cabinets and that more than 70% of all stores have walk-in refrigerators. Use of open cases is on the decline because of their energy inefficiency. As a result, only about 30% of food stores still use open refrigerated display cases.

The size and layout characteristics of refrigeration systems vary widely. Some stores use a centralized refrigerating plant that pipes refrigerant to and from remote cooling coils; however, other stores use small, self-contained refrigeration systems. Pressurized refrigerant vapor is piped from the compressors through a condenser that removes excess heat and causes the gas to liquefy. The liquid refrigerant is then piped into an expansion valve in the display case (which is sometimes as much as 300 feet away) where its pressure is reduced and its temperature drops even more. The cold liquid passes through evaporator coils where it picks up heat and reverts to vapor, chilling the air in the case. The refrigerant finally returns to the compressors to complete the cycle. In some systems, a desuperheater is placed between the compressors and the condenser to reclaim waste heat for water or space heating. Waste heat recovery via desuperheater is most practical in centralized systems.

Efficiency Technology Solution
Energy-Efficient Refrigeration Technologies

Convenience and grocery stores can cut refrigeration electricity use by as much as 25–30% by adopting energy-efficient refrigeration technologies, such as the following

Humidity Control. In many regions of the country, one of the most effective ways to increase refrigeration efficiency is to reduce the humidity of the store. Excess moisture in the air leads to frost buildup in display cases, resulting in decreased evaporator coil efficiency, the need for more frequent defrost cycles, longer operating time for anti-sweat heaters, and product deterioration.

High-Efficiency Compressors. Compressor efficiency has improved 10–15% since the mid-1980s, and new compressors can save 5–7% on a store's refrigeration bill. In new installations, or when replacing failed units, high-efficiency compressors are a

worthwhile investment. High-efficiency compressors pay for themselves quickly, reducing both electricity use and demand.

Floating Head Pressure. Floating head pressure is a control strategy that adjusts a compressor's refrigerant discharge pressure or head pressure according to the outside temperature. Specifically, the strategy involves controlling the fans on an evaporative-cooled condenser in response to changes in temperature. On cold days, when the condenser is rejecting heat to a lower ambient temperature, the compressor discharge pressure and temperature can be reduced; this increases system efficiency. On warmer days the evaporative-cooled condenser is more energy-efficient than a conventional water-cooled condenser.

Multiplexing Compressors. Multiplexing compressors is a strategy that involves the use of a bank of compressors of different sizes in place of individual compressors dedicated to specific refrigeration loads. Programmable electronic controls cycle the compressors on and off to match capacity according to changing refrigeration loads. Conventional compressors waste energy by running at a greater capacity than is needed at any given time. The multiplex system uses fewer compressors and less horsepower to handle the same refrigeration load more efficiently.

High-Efficiency Fan Motors for Refrigerated Display Cases. The display cases in convenience and grocery stores can use many fractional-horsepower (25- to 100-watt) motors for air circulation fans. Conventional low-efficiency motors are typically used in this application. However, since the motors run 24 hours a day, use of high-efficiency motors can result in substantial energy savings.

Energy-Efficient Display Case Doors. Use of reach-in cases with doors saves a significant amount of energy compared to open units. Doors are typically used on low-temperature display cases but not on medium-temperature cases. Although closed cases are not as convenient for customers, they are far more efficient than open cases. Because even medium-temperature cases are affected by the surrounding temperature and humidity, they should have doors, too, unless doors substantially interfere with product marketing and sales.

Hot Gas Defrost. Frost develops when a humid airstream contacts a cooled surface at temperatures below the dew point (or freezing point). When frost develops on the cooling coil surfaces of heat pumps and refrigeration equipment, it can decrease equipment efficiency up to 25%. Hot gas defrost is an energy-saving alternative to electric resistance defrost. It uses waste heat in the form of high-temperature refrigerant gas to melt the frost that accumulates on the evaporator coils. This system channels hot gas from the compressor discharge, or warm gas from the condenser, to display cases for defrosting. Hot gas defrost is cost-effective for new facilities and can save 3% on refrigeration bills when compared to electric defrost.

Anti-Sweat Heater Controls. Anti-sweat heaters are used in display cases to prevent condensation on door surfaces that are exposed to warm, moist air from the sales area. The heaters typically operate continuously, regardless of inside moisture levels, thereby wasting energy. Anti-sweat heater controls respond to interior dew-point levels and ensure that the heaters operate only when needed. These controls offer electricity savings of 4% and a payback of just over one year.

Energy-Efficient Display Case Lighting. Electronic lighting systems—innovative, cooler lighting equipment that reduces glare and produces brighter, more even light—are recommended when purchasing new display case doors. These systems use a standard T-8 fluorescent lamp (i.e., tube) that provides higher light output than the traditional T-12 lamp and reduces the heat load for additional energy savings. The optical lens of an electronic lighting system also directs light uniformly across the width of a shelf, reducing side glare. Although these systems cost more to install than conventional lighting options, the advantages can outweigh the additional first cost.

An EPRI supermarket test facility that implemented high-efficiency refrigeration improvements achieved a nearly 27% electricity savings. Of the overall savings, 8% was attributable to multiplexing compressors, 6.7% to subcooling, 6% to an evaporatively cooled condenser, 3.4% to floating head pressure, and 2.6% to hot gas defrost. The system also reduced peak demand 28–40%. Many of these improvements can be applied to smaller food stores to provide similar savings.

When purchasing a new refrigeration system or new refrigeration components, a c-store or small supermarket owner and/or operator is understandably highly concerned about equipment reliability and performance. These characteristics are essential to prevent costly food spoilage and lost sales in the case of system failure. Energy efficiency is a secondary interest. New energy-efficient products must prove themselves in the areas of high performance and reliability standards before operators will consider purchasing them.

Partnering Opportunity
CFC Education

The grocery store industry is also facing some capital investment requirements to replace refrigeration and heating, ventilation, and air conditioning (HVAC) equipment that will become obsolete due to the January 1996 phaseout of chlorofluorocarbon (CFC) production in the United States. While some supermarket and c-store operators may have already formulated a CFC-replacement strategy, many others may need information on the advantages and disadvantages of available alternatives, such as absorption chilling and ammonia-based technologies, as well as the use of hydrochlorofluorocarbons (HCFCs), glycol, and nonchlorine refrigerants.

This situation presents a partnering opportunity for utilities to provide educational information on CFC alternatives and to help owners and/or operators of grocery stores review HVAC and refrigeration options and calculate pay-back periods for replacement of equipment.

Lighting

Lighting is an important part of c-store or supermarket operation, especially for stores that require 24-hour illumination and extensive outdoor security and display lighting. Consequently, lighting is the second largest user of electricity in the food sales industry, accounting for about 20% of the total electricity use in c-stores and 25% in supermarkets.

Lighting accounts for a larger percentage of supermarket electricity use because indoor lighting levels are typically higher. Supermarket indoor lighting is a key attribute that affects shoppers' perceptions of store cleanliness, product quality, and overall store comfort, all of which significantly influence customer loyalty. In c-stores, the relationship between lighting and customer purchasing behavior is weaker, since customers are usually in a store only for a short period of time to purchase a few specific items.

C-stores and supermarkets are typically either under-lit or over-lit. Aisles, high shelves, and display cases make these stores difficult to light properly. If aisles are not well lit, customers cannot read labels or easily survey products on the top and bottom shelves. To combat this problem, facility managers tend to install a large number of fixtures. However, this strategy can produce an uncomfortable glare for both customers and employees, as well as an increase in overall energy use and operating costs. Indoor lighting levels affect sales revenue; good lighting encourages customers to spend more time—and money—in a store and helps to retain employees by providing them with a more comfortable and productive work environment.

Outdoor lighting is also part of a c-store or supermarket's electricity bill. Typical outdoor lighting ranges from incandescent lamps used in store signs to high-intensity discharge lamps such as mercury vapor, metal halide, or high-pressure sodium, which are used in parking lots and loading dock areas. High-intensity discharge lamps also are used for facade lighting of a building. Due to the around-the-clock operations of many c-stores, outdoor lighting represents 9% of their total electricity use, versus 4% for supermarkets.

Efficiency Technology Solution
Energy-Efficient Indoor Lighting

A typical c-store or supermarket uses standard fluorescent lighting (34- or 40-watt lamps with electromagnetic ballasts) with manual lighting controls. Approximately 40% of all stores also use some incandescent lighting. Updated lighting designs can improve sales, energy efficiency, and the store environment. For example, existing fluorescent or incandescent lamps used for area lighting can be retrofitted with T-8 fluorescent lamps with electronic ballasts to achieve significant electricity savings. The addition of dimming controls allows a store to take advantage of daylighting. Display lighting is best accomplished with compact fluorescent, halogen, or metal halide lamps. The good color rendition of these lamps is especially important in produce and meat departments. Lamps with a color rendition index of 80 or more generally provide the best colors. Cool-beam track lighting, a low-heat lighting technology, is particularly suited for use in produce departments.

Many stores leave lights on in the sales area and display cases during nonpatron hours to provide illumination for restocking. Electronic or manual lighting controls can be used to turn off half of the sales area lighting and all of the display case lighting during these hours or when restocking is not necessary. This can save both lighting and refrigeration system energy use.

Electrotechnology Solution
Energy-Efficient Outdoor Lighting

Most outdoor lighting retrofit projects (for example, relamping with more energy-efficient lamps or adding seasonally adjusted lighting controls) have the potential to significantly reduce electricity use in terms
of watts per square foot. Other important benefits can be achieved by increasing outdoor lighting levels to reduce the potential for crime, increase customer and employee safety, and enhance a store's nighttime visibility and appearance.

Heating, Ventilation, and Air Conditioning

Convenience and grocery store HVAC systems differ significantly from other commercial building systems: The main goal of a convenience or grocery store HVAC system is to control humidity rather than temperature. Many grocery stores have high humidity. When water is sprayed to freshen produce, moisture is added to the air. As refrigerated cases draw the moisture out of the air, frost appears on cold surfaces, clouding the front of display cases and detracting from the appearance of food items, possibly reducing sales. Humidity also decreases the efficiency of a refrigeration system as it contributes to the buildup of frost on the refrigeration coils. Because refrigeration accounts for more than half the electricity used in both c-stores and supermarkets, the

potential savings from reducing humidity and improving refrigeration efficiency are substantial. In regions characterized by high humidity, removing moisture from the indoor air is the most effective way to increase refrigeration efficiency.

Coordinating the operation of the HVAC and refrigeration systems improves the efficiency and increases the reliability of both systems. Maintaining proper indoor humidity and temperature, even during off-hours, keeps the compressors properly loaded and prevents frost formation on the refrigerator coils. Packaged systems that combine HVAC and refrigeration equipment are available. These systems provide a cross-over connection between HVAC and refrigeration equipment, resulting in backup operation protection in the event of failure of either type of equipment. This increased reliability gives store operators greater insurance against product spoilage and/or customer discomfort.

Convenience Store

While HVAC systems consume 20% of c-store electricity, the systems themselves do not play a large role in the operation of a store other than to keep humidity in check to benefit the refrigeration system. In most c-stores, customers are in and out quickly, usually in less than two minutes. Therefore, there is little need for accurate temperature control or for careful air distribution.

C-store buildings typically have full glass fronts; these contribute to solar heat gain in the summer and thermal heat loss in the winter, the significance of which depends on the orientation of the storefront. While the year-round internal heat gain from people is relatively small, the electric appliance heat load—from coffee makers, popcorn machines, hot dog cookers, chicken roasters, and/or small refrigerators—can contribute significantly to the internal heat gain of a store. The high customer turnover rate results in an unusually high infiltration of outside air.

Most c-stores are equipped with single-zone, rooftop packaged air conditioners with gas or electric heat. Electric resistance heating is often used because the relatively small load does not justify the expense of installing gas lines. Some stores have heat pumps, but the paybacks are often too long for investment since most stores' primary heating loads are at low ambient temperatures. Heat reclaimed from refrigeration circuits is typically not used for space heating, again because the small load does not warrant the complexity and expense. In addition, it is common for c-stores to shut off air conditioning systems at night to reduce energy use. While effective for this purpose, air conditioner shutdown can result in increased refrigeration electricity use and produce a relatively small net energy savings.

In general, c-stores are so basic in their design and equipment that little opportunity exists to introduce high-efficiency HVAC alternatives, except when replacing

equipment that has failed. In the meantime, simple measures such as window shading and good maintenance practices can help to reduce energy costs.

Small Supermarket

HVAC consumes 11% of total supermarket electricity. While this is a smaller percentage than for c-stores, HVAC plays a much more important role in a supermarket facility. A supermarket has a much higher occupancy density and humidity load, and therefore has more complex HVAC requirements.

Most supermarkets use conventional rooftop HVAC units. In a rooftop system, outdoor air is mixed with return air, and the entire airstream is cooled to 52–56°F by a standard vapor compression system similar to that used for refrigeration; humidity is also reduced to approximately 55%. Experience has shown, however, that overall energy costs for many stores can be minimized by maintaining relative humidity between 40–45%. In supermarkets, controlling relative humidity to as low as 40%, instead of the conventional 55%, can reduce refrigeration requirements by 10–15%. To reduce humidity to this optimum level, a conventional HVAC system must operate longer than usual. This overcools the air, which must then be reheated to avoid uncomfortably low temperatures within the store. Reheating is accomplished by reclaiming waste heat from the refrigeration system or by using electric heating coils. While this process reduces humidity to an optimum level, it does so at a higher energy cost.

Several high-efficiency electric alternatives for dehumidification of convenience and grocery store air are available. High-efficiency electric dehumidification is an effective, low-cost method of improving store comfort. Coordinating dehumidification with the operation of refrigeration and HVAC systems through a control system can keep system compressors operating at efficient loads and prevent the formation of frost on refrigeration coils. Alternatively, electric desiccant dehumidification systems can be used to remove ambient moisture (i.e., reduce a store's latent cooling load). Although these systems have attained only a small market share, they represent a cost-effective dehumidification alternative for stores that have insufficient cooling capacity.

In addition to dehumidification technologies, heat recovery and thermal energy storage can help to reduce HVAC-related energy costs in some convenience and grocery store applications.

Desiccant Dehumidification

Desiccant dehumidification systems provide an alternative method of improving store comfort. Desiccant dehumidification relies on the moisture-absorbing qualities of compounds known as desiccants. In these systems, indoor air is passed across a material that absorbs or adsorbs ambient moisture. Once the desiccant material has

reached its moisture-carrying capacity, however, it must be regenerated. In regeneration, air heated by either gas or electricity pulls the moisture out of the desiccant. The energy of the hot desiccant mass is then transferred to the indoor air and must be removed by the primary cooling system.

Gas-fired desiccant systems are frequently used in conjunction with electric air conditioning in grocery stores. Gas-fired systems typically regenerate desiccant at higher temperatures than electric systems; this results in their placing a greater relative cooling load on the store's HVAC system. Some electric desiccant dehumidification systems use waste heat from a heat pump to regenerate desiccant and offer relatively high operating efficiencies. Although electric systems are effective, the wide availability of gas-fired models has kept electric desiccant dehumidification systems from attaining a large market share.

Efficiency Technology Solution
High-Efficiency Electric Dehumidification

High-efficiency electric dehumidification systems can save supermarkets a significant amount of electricity. These systems dehumidify using a lower-temperature coil and condition only enough air to achieve the required humidity level. The remainder of the air bypasses the cooling coil. This minimizes overcooling and reduces the need to reheat the conditioned air. The dual-path and improved single-path electric HVAC systems are economically attractive and can be enhanced by the addition of a heat pipe heat exchanger. A heat pipe heat exchanger can be useful in a store that exhausts a lot of indoor air and takes in a lot of outdoor air. Bringing in unconditioned outdoor air can heavily burden an HVAC system. A heat pipe heat exchanger, which transfers energy from the exhaust airstream to the incoming air, lessens the demand on the HVAC system.

Efficiency Technology Solution
Heat Recovery

In addition to dehumidification, a convenience or grocery store can reduce its energy bill by reclaiming heat from compressor discharge gas and using it to supply up to 100% of a store's annual space heating and water heating requirements. Heat recovery effectiveness can be enhanced by capturing heat rejected from both the refrigeration and HVAC systems. This heat recovery advantage is often built into packaged systems that combine both services. These systems tend to be highly reliable and efficient, allowing balanced loading of the compressors during normal operation and cross-connection of the refrigeration and HVAC systems during equipment failure or maintenance periods. Due to additional piping and heat exchanger requirements, heat recovery is most cost-effective when incorporated into the initial design of store HVAC and refrigeration systems.

Emerging Efficiency Technology Solution
Thermal Energy Storage

Thermal energy storage (TES) for cooling refers to the process of chilling a mass of ice or a water-antifreeze mixture during off-peak hours and then releasing its cooling potential during peak hours to supplement or eliminate operation of the conventional cooling system during those hours. Using TES to shift the operation of cooling equipment to off-peak hours confers two primary benefits:

- The facility's peak energy consumption, which is usually reached during periods of large cooling loads, is reduced. TES shifts a large part (or all) of chiller operation to low-load hours, thereby smoothing out a facility's load profile and potentially providing significant demand charge savings.
- The overall energy consumption of the facility's cooling equipment is potentially reduced. Often, continuous operation of a cooling system is more efficient than the on-off operation of a system working to satisfy real-time cooling demands.

TES systems are now well-proven for applications with large cooling loads. Investing in the technology is more economically justifiable when its costs are compared with the energy savings and demand charge savings of a large cooling system. However, most small commercial businesses, including convenience and grocery stores, use relatively small cooling systems of 10–20 tons. In recognition of the substantial market potential for small-scale TES, equipment manufacturers are developing, testing, and demonstrating TES systems that are effective and economically practical for these applications.

Field tests have shown that TES is a viable technology for lowering energy costs and peak demand charges. TES equipment can be retrofit into an existing HVAC system with minimal modification. Alternatively, TES is easily incorporated in initial HVAC system design.

Foodservice and Other Equipment

In both c-stores and small supermarkets, 10–14% of electricity use is for foodservice, water heating, and other equipment.

Foodservice

Virtually all c-stores and some supermarkets utilize electric-based foodservice appliances, including microwaves, hot dog steamers and roller grills, popcorn machines, and coffee machines. In addition, many new and remodeled stores are expanding their foodservice capabilities to meet current consumer demands. Some are

entering into partnerships with fast-food chains such as McDonald's and Taco Bell to offer shoppers on-site access to nationally known brands. Others are expanding in-store bakery or deli operations and using equipment such as dough proofers, ovens, fryers, steamers, broilers, and/or microwave ovens.

Since the majority of foodservice operating costs are for food and labor, equipment energy use may be viewed as simply a necessity and given little attention. Indeed, once equipment is purchased, there are few ways to moderate its electricity use. One step is to turn equipment off when the store is closed, or install "power saver" devices that reduce energy usage when equipment is idle. Some stores may also stagger the startup of appliances to avoid peak demand charges.

Electrotechnology Solution
Electric Foodservice Equipment

A number of new electric foodservice appliances are available to grocery stores. In addition to the now ubiquitous microwave oven—used to thaw and reheat food—this equipment includes the following:

FlashBake Oven. The FlashBake oven cooks food quickly with a combination of visible light and infrared radiation. It can cook nachos in 30 seconds, a pizza in 60 seconds, and a salmon fillet in 120 seconds. The oven is energy-efficient because there is no preheat time, and no energy is wasted in maintaining the cooking temperature. In addition, short cooking times minimize the heat emitted to the kitchen area, reducing space-conditioning costs and providing more comfort for workers.

Induction Range. An induction range uses a magnetic field to transfer energy from a coil underneath the cooktop to the cookware. Pots and pans of 430 stainless steel or cast iron turn the magnetic energy into heat. A key benefit is instantaneous heat, which provides energy efficiency and gives cooks precise control. In addition, the top of the induction range remains cool to the touch, increasing worker safety and facilitating cleanup.

Combination Oven-Steamer. Known as a "combi-oven," this electric cooking technology combines five appliances in one: a convection oven, a pressureless steamer, a wet roaster (combining dry heat and steam), a proofer for dough, and a cook-and-hold appliance. The technology allows menu flexibility, saves space, and, as a result of its programmable controls, can also increase productivity.

Electric Fryer. Electric fryers are two to three times more efficient than conventional gas fryers at peak production rates, and up to four times as efficient at lower (more common) production rates. This high energy efficiency often compensates for the higher price of electricity. In addition, the technology can help to extend fat life, thereby reducing fat costs.

All of these electric cooking technologies have the advantage of higher efficiency, faster cooking times, reduced generation of heat in the kitchen, and lower operating and maintenance costs. The Electrotechnology Profile in Section 4 provides more details on these technologies.

Water Heating

For supermarkets and c-stores, the energy consumption associated with water heating is minimal. Most stores have small 15- to 150-gallon electric or gas storage water heaters. Hot water is generally used during off-peak hours for cleaning the store and foodservice utensils. Supermarkets and c-stores with deli and food preparation areas use more water and require larger tanks. However, even in these cases, the energy use is often too insignificant to justify alternative methods.

Efficiency Technology Solution
Desuperheater

A supermarket can incorporate a desuperheater in its refrigeration system to obtain hot or preheated water. With a desuperheater, hot refrigerant gas is piped from the compressor through the desuperheater—a refrigerant-to-water heat exchanger—to the condenser to complete the refrigeration cycle. The waste heat collected from the refrigerant is passed on to the water storage tank, to heat the water inside. The amount of heat recovered depends on the amount and temperature of the refrigerant and the quantity of water being used. Desuperheaters are totally passive systems with no moving parts and practically no maintenance; they can provide quick payback in both new and retrofit situations.

In some supermarkets, heat reclaimed by a desuperheater can meet all of a store's water heating needs. Aside from reducing or eliminating the cost of water heating, a properly installed system can increase the efficiency of air-cooled condensing units and/or reduce the quantity of water required by the condenser for water-cooled condensing units.

Even a small, 1-horsepower compressor for a walk-in cooler has a significant amount of waste heat—almost 12,000 Btu of waste heat per hour, equal to about 4 kWh or one-fifth of a therm of gas. The value of this waste heat can vary from $0.10 to $0.60 an hour, depending on rates.

Other

Another type of equipment used increasingly by c-stores and supermarkets nationwide is the purified-water vending machine. As public concern over water quality has risen

over the past decade, more and more c-stores and supermarkets have installed these vending machines to offer customers a less expensive alternative to bottled water.

Electrotechnology Solution
Purified-Water Vending Machines

According to federal law, the treatment of drinking water must include the disinfection of pathogenic (disease-causing) microorganisms. Chlorine, which is both effective and inexpensive, has been the primary disinfectant used to date. However, several harmful side effects have been identified, the most important being that its disinfection by-products include known carcinogens.

The new purified-water vending machines use granulated activated carbon, reverse osmosis, and ultraviolet (UV) disinfection technology, often two or all three together, to kill microorganisms and filter out or remove heavy metals or volatile organic compounds.

4

ELECTROTECHNOLOGY PROFILES

This section provides profiles of the electrotechnologies identified in Sections 2 and 3. Each profile explains the technology, its advantages and disadvantages, commercial status, and costs. The profiles have been designed as stand-alone descriptions so that they can be utilized separately from the rest of this guide. For further information, turn to Section 5 for a list of equipment vendors that can provide specific details.

Outdoor Lighting

Basic Principle

Many small businesses benefit from enhanced outdoor lighting through reduced potential for crime, increased employee safety, and improved visibility and attractiveness of the facility.

These benefits are obtained for a relatively small operating cost because, in most cases, outdoor lighting does not contribute to a facility's peak electrical demand. This means that the average energy cost for outdoor lighting (in terms of cents/kWh) is typically less than the energy cost of other improvements.

Typical Outdoor Lighting Applications

Type of Light	Exterior Signage	Parking Garages	Parking Lots/ Driveways	Walkways	Facade and Landscaping
Incandescent	■			■	■
Compact Fluorescent		■		■	■
Fluorescent	■	■		■	■
Metal Halide		■	■	■	■
High-Pressure Sodium			■		
Mercury Vapor			■		

Note: Additional applications are possible for each of the lighting types, but the chart identifies the most efficient applications for each of the light sources. Low-pressure sodium lamps are not normally used in small businesses because of their poor color quality.

There are three principal methods for using outdoor lighting in small businesses:

1. Signage on the exterior of the building or illuminated signs near the building to generate attention for the building or the small business
2. General lighting in parking lots, driveways, parking garages, and walkways
3. Facade lighting to increase the visibility of the structure and surrounding architectural features and landscaping

Different lighting technologies are typically used for different applications. Existing lighting systems can often be retrofitted or replaced by energy-efficient lighting systems. In addition, existing lighting systems can be supplemented with new lighting systems to increase safety, security, visibility, and name recognition.

System Description

Mercury vapor, high-pressure sodium (HPS), and metal halide lamps are referred to as high-intensity discharge (HID) lamps. Metal halide lamps and HPS lamps provide approximately 100 and 140 lumens per watt, respectively, while mercury vapor lamps provide up to 60 lumens per watt. Mercury vapor lamps emit a blue-green light, while HPS lamps emit a yellow-orange light. Metal halide lamps emit a predominately white light. Most HID lamps require a spacing-to-mounting height ratio of 1.0–1.9, which means that the spacing is roughly one to two times the pole height.

Each HID lamp requires a specific ballast to drive the lamp; however, some manufacturers offer metal halide and HPS lamps that can be operated by a mercury vapor lamp ballast. This allows easier conversion from inefficient mercury vapor lamps to higher-efficiency metal halide and HPS lamps. HID lamps are available in a variety of wattages from 35–1500. The HID ballast adds approximately 8–15% to the wattage of the lamp.

Fluorescent lamps are also used as outdoor lighting sources for small businesses. Conventional 4-foot and 8-foot tubes are used in many parking garages and covered walkways. Compact fluorescent lamps are also becoming popular as replacements to incandescent lamps in stairways. Newer T-8 lamps and electronic ballasts are approximately 30% more energy-efficient than older 40-watt T-12 lamps with magnetic ballasts.

Incandescent lamps are the least efficient form of outdoor lighting. However, incandescent lamps are still used as spotlights on signs and as floodlights on building facades and landscaping. The short lifetime of incandescent lamps often has a bigger impact on operating costs than does the additional energy use.

Common controls used for outdoor lighting systems include time clocks, photocells, and programmable controllers.

Typical Lamp Characteristics for Outdoor Applications

Type of Lamp	Typical Wattages	Initial Lumens/ Watt	Avg Rated Life (h)
Incandescent	60–1,500	15–24	750–2,500
Compact Fluorescent	12–35	25–75	8,000–12,000
Fluorescent	20–215	50–100	9,000–20,000
Metal Halide	175–1,500	69–115	10,000–20,000
High-Pressure Sodium	35–1,000	51–140	7,500–24,000
Mercury Vapor	40–1,000	24–60	12,000–24,000

Note: Initial lumens/watt includes ballast losses.

Advantages

Well-designed outdoor lighting systems can offer the following advantages:

- Increased perception of comfort and friendliness
- Increased security for customers and employees
- Reduced accidents in driveways, parking areas, and walkways
- Increased visibility for the facility and the small business

Disadvantages

Other than installation and operating costs, there are no overall disadvantages of outdoor lighting. However, specific lamps do have weaknesses:

- HID lamps require 2–7 minutes to warm up before reaching full output.
- Metal halide lamps require up to 15 minutes to cool before restrike.
- Special low-temperature fluorescent lamps are required in cold climates to maintain a relatively constant lumen output when temperatures are below freezing.

Commercial Status

All of the lamps described above are readily available from a variety of manufacturers. However, mercury vapor and older T-12 fluorescent lamps are being phased out of production.

Gradual improvements have been made in the efficiency of outdoor lighting systems. In addition, color-corrected HPS lamps are available, as well as improved metal halide lamps that contain incandescent or fluorescent lamps that come on if the power is interrupted.

EPRI Information

Additional information on lighting technologies is available from the EPRI Lighting Information Office, (800) 525-8555.

Foodservice Equipment

Basic Principle

A large selection of new electric technologies is available to support the foodservice needs of small businesses. Many of these technologies are well known because they have already been adopted in the residential market, such as microwave ovens. Other technologies are newly developed, such as the FlashBake oven, the induction cooktop, the combination oven-steamer, and the solid-state electric fryer.

FlashBake Oven

The FlashBake oven is a countertop lightwave oven that uses infrared energy to brown food surfaces, and intense visible light to cook food from the inside out in an extremely short amount of time. For example, a fresh 9-inch pizza can be cooked in 60 seconds, or quesadillas in just 30 seconds. In addition to speed, the FlashBake oven delivers product quality equal to or better than conventional ovens. The ovens are energy-efficient, cool to work around, and require no ventilation. The **FlashBake** oven is a trademarked product of Quadlux, Inc.

Induction Cooktop

The induction range consists of a flat ceramic cooking surface over an induction coil; heat is generated only in the cooking pot without heating the cooktop surface. These units are instant “on” and “off,” producing very high energy efficiency and quick cooking (8 ounces of water will boil in 30 seconds). They are cool and safe to work near

and extremely easy to clean. Ferrous metal pans, made of materials such as 430 stainless steel or cast iron, must be used with these ranges.

Combination Oven-Steamer

The combination oven-steamer, also referred to as a "combi-oven," can perform all the functions of either a convection oven or a convection steamer, or combine these functions to allow cooking at higher temperatures in a moist environment. The combi-oven effectively replaces three pieces of equipment with a single unit, which saves first cost, kitchen space, and hood requirements. It is appropriate for roasting meats; steaming vegetables, rice, and shellfish; baking breads and pastries; and reheating previously cooked foods.

Solid-State Electric Fryer

Electric fryers have much higher operating efficiencies than equivalent gas fryers and afford better temperature control of the frying medium, helping to reduce the amount of overcooked food and extend fat life (thereby reducing costs and waste). The new solid-state fryer significantly increases electric fryer reliability by replacing electromagnetic controls with solid-state controls. It is also noted for very high efficiency and easy cleaning. It is especially well-suited to low- and medium-volume applications because electric efficiency is very good in comparison to gas fryer efficiency in these situations. Gas fryers lose efficiency in part-load applications (short usage followed by idle time) due to excessive flue losses.

Other Equipment

Other electric cooking appliances offer a variety of benefits. The advanced/innovative electric equipment includes

- Induction fryer
- Convection/microwave oven
- Air impingement/microwave oven
- Convection/steam/microwave oven
- Skittle
- Rofry (oil-free fryer)
- Electric rotisserie
- Electric conveyor broiler
- Blast chiller

Advantages

- The first cost of electric equipment is generally lower than that of equivalent gas models.
- Electric equipment is typically lighter than its gas counterparts, making it easier to move and less expensive to ship.
- The footprint of electric equipment is generally smaller, which saves valuable kitchen space.
- Electric equipment maintenance costs are generally lower.
- Electric equipment is easier to clean, which saves labor.
- Electric equipment cooks food more quickly and has a faster recovery time, which can improve productivity.
- Better temperature control can reduce waste by ensuring that foods are not overcooked.
- Electric equipment radiates less heat to a kitchen, which reduces air conditioning costs and makes the equipment cooler to work around.
- Because no gas lines are required and electric equipment does not always have to be under a hood, electricity provides increased flexibility in kitchen layout.
- Overall, electricity provides a cleaner and safer work environment.

Disadvantages

- Adding electric equipment may require electrical upgrades.
- Some chefs prefer gas equipment because they can see the flame, like the instantaneous response, were trained on gas equipment, and/or have not compared the options side-by-side.

Commercial Status

All of the technologies described above are commercially available. However, some of the technologies are only available from one manufacturer.

Cost and Electrical Requirements

Cost and electrical requirements vary significantly from one technology to the other. To estimate the cost of a specific application, the type of food being prepared, the cooking technique, the physical size of the food, and the quantity of food processed must be known. In mid-1996, the list price for a 28 x 29" FlashBake oven was $4400; the list price

for a 50-lb, 14-kW induction range was $6710; the list price for a 14-pan (12 x 20") combi-oven was $18,636; and the list price for a 50-lb solid-state fryer was $4100.

EPRI Information

A *Business Guide to Foodservice*, TR-106841, November 1996.

Foodservice Equipment Applications Handbook, TR-105991, March 1996.

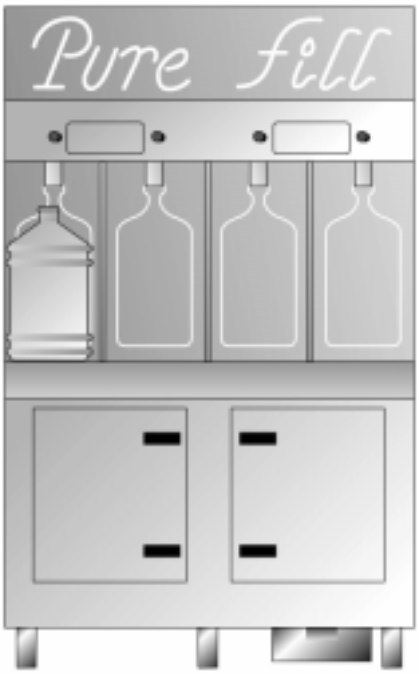
Copies of these publications are available from the EPRI Distribution Center, (510) 934-4212.

Purified-Water Vending Machines

Basic Principle

Due to several recent drinking water contamination incidents that endangered public health, public concern about the safety of drinking water supplies is on the increase. In fact, the quality of tap water has become so poor in some areas that the U.S. Centers for Disease Control and Prevention (CDC) and the Environmental Protection Agency (EPA) issued a warning in mid-1995 to people with weak immune systems noting the risks of drinking tap water. The primary health threat in many of the reported incidents was *Cryptosporidium parvum*, a parasite that can cause severe diarrhea and nausea and that can be found in as much as one-third of the public drinking water supply. While healthy individuals often recover from exposure in about 10 days, the parasite can be deadly to children, elderly people, people with AIDS, and others with weak immune systems.

Aside from health and safety issues, many consumers also avoid tap water for aesthetic reasons. Water disinfected with chlorine often has a distinct smell, and water from wells can smell like sulfur. Consumers who find these odors offensive prefer the alternative of purified water. Convenience and grocery stores can meet consumer demands for purified water by installing vending machines that dispense treated, nonodoriferous drinking water.



Purified-Water Refill Center

Source: Pure Fill Corporation

System Description

Purified-water vending machines rely on various processes, often in combination, to treat water. These processes or technologies include granular activated carbon, reverse osmosis, and/or ultraviolet (UV) disinfection.

- Granular Activated Carbon: Granulated activated carbon filters use activated carbon (carbon that has been heat-treated to increase its surface area) to adsorb impurities from water. The impurities can include pesticides, volatile organic compounds, synthetic organic compounds, some radiological constituents, fluoride, chlorine, and some heavy metals. Many vending machines increase the effectiveness of activated carbon by adding a slight positive charge to the carbon; this enhances its ability to attract the impurities.

  One disadvantage is that granular activated carbon filters collect microbiological organisms over time, and these can ultimately contaminate the water. As water passes through the filter, bacteria become trapped in the substrate and multiply in the warm, moist, oxygenated environment. As a result, filtered water can contain bacteria, especially the first water filtered after a lapse of hours. In addition, the filter will eventually reach capacity

and require replacement (typically after 3–12 months of use). Replacement cartridges are sold by the vendor and cost about $45 per cartridge.

- Reverse Osmosis: Reverse osmosis is a membrane separation technique that utilizes permeable membranes to filter selected components from drinking water. The membrane filters molecules on the basis of their shape and size. This process can be used to reduce the levels of heavy metals, volatile organic compounds, chlorine, and *Cryptosporidium* that may be present in drinking water.

  One concern is that the reverse osmosis water reservoir can be a breeding ground for *Pseudomonas* bacteria, which thrive in low-nutrient or ultra-pure water. This bacterium is relatively harmless to healthy individuals but may cause problems for people with weak immune systems. Reverse osmosis filters also must be cleaned periodically, to unclog the filter pores. Cleaning is accomplished by backpulsing or reversing the flow of the clean permeate. Backpulsing keeps the membrane clean over extended periods of time so that only occasional chemical cleaning is required.

- Ultraviolet Disinfection: UV irradiation disinfects drinking water in two ways. First, UV energy excites the water molecules into a higher energy state, which results in the release of hydroxyl-free radicals (OH^-) that then quickly attack and break down exposed carbon bonds in any organic compounds present. Second, UV irradiation kills bacteria by penetrating the microorganisms' cell walls and photochemically breaking down their DNA, thus preventing them from reproducing.

  While UV disinfection is effective against many kinds of microorganisms, it does not kill *Cryptosporidium* or *Giardia* (another parasite), nor does it remove chemicals, lead, or asbestos. Also, UV irradiation is less effective if the water contains a lot of iron or is turbid (cloudy).

To overcome the specific limitations of any one water purification technique, many water vending machines combine two or all of these three methods, thereby eliminating most water contamination problems. One measure of the effectiveness of a water vending machine is certification by the National Automatic Merchandising Association (NAMA). Manufacturers voluntarily submit their products to NAMA for certification. NAMA certifies water vending machines through water quality testing according to standards set for turbidity, total dissolved solids, total coliform (a measure of microorganism contamination), pH, chloride, sulfate, and lead.

Advantages

- Generates revenue: An outside water vending machine operates 24 hours a day, generating around-the-clock profit whether a store is open or not.

- Requires little maintenance: The system(s) requires limited maintenance—just cleaning and replacement of filters, membranes, and/or UV lamps.
- Reduces impurities: Levels of bacteria, viruses, chemicals (such as chlorine), and heavy metals are dramatically reduced or eliminated in most cases.
- Requires minimum space: Most vending machines are compact—not much larger than a soda or candy vending machine.

Disadvantages

- Subject to scaling: Deposits can precipitate on the filters, membranes, or UV lamps that eventually prevent adequate purification if they are not removed.
- No disinfecting residual: With chlorine disinfection, the presence of residual chlorine serves to prevent further contamination.

Commercial Status

On-site water purification units specially designed for small commercial use are commercially available; they have been providing high-quality drinking water in supermarkets and convenience stores since 1983. Many vendors offer several models of water vending machines that purify water using a combination of granulated active carbon filters, reverse osmosis, and/or UV disinfection methods.

Cost and Electrical Requirements

The cost and electrical requirements of purified-water vending machines differ widely, depending on the vendor and the models available. The machines generally require 0.6 to 3.6 kW of electricity, and cost $2700 to $12,000, depending on the features chosen. Actual electricity consumption (kWh) per day is difficult to calculate because it depends on how much a machine is used. Some models are in-store water refill centers, while others are coin-operated machines. Models also differ in water treatment capacity (some produce as little as 75 gallons per day, others as much as 3000 gallons per day), and water treatment method (granulated activated carbon, reverse osmosis, and/or UV disinfection).

Purified-Water Vending Machine Characteristics

Dimensions	Width: 20–59" Depth: 19–38" Height: 43–80"
Weight	150–825 lb
Capacity	75–3000 gal/d
Power Rating	0.4–3.6 kW
Key Inputs	
Power	Electricity
Other	Water
Key Outputs	
Solid Waste	Residue must be removed from reverse osmosis filters periodically
Air Emissions	None
Water Effluent	None
Cost	
Purchase	$2700–$12,000
Installation	1–10% of purchase price
Other Supplies	Water costs, replacement carbon cartridges, and/or maintenance to clean reverse osmosis filters and prevent scaling on UV lamps

5

RESOURCES

This section contains three lists: 1) equipment suppliers for the electrotechnologies profiled in this guide, by equipment type; 2) EPRI information resources on efficiency technologies; and 3) convenience and grocery store trade associations. The information used to compile these lists was based on a combination of a telephone survey, published reports, directories, buyer's guides, and technical journals. The information was current at the time of publication and is expected to change over time.

Outdoor Lighting

Equipment Suppliers

Bairnco Corp.
2251 Lucien Way, No. 300, Maitland, FL 32751
(407) 875-2222, fax: (407) 875-3398

Bieber Lighting Corp.
970 W. Manchester Blvd., Inglewood, CA 90301
(213) 776-4744, fax: (310) 216-0333

Bulbtronic, Inc.
45 Banfi Plaza, Farmingdale, NY 11735
(800) 647-2852, (516) 249-2272, fax: (516) 249-6066

Carlon (Lanson & Sessions Co.)
25701 Science Park Dr., Cleveland, OH 44122
(216) 831-4000, fax: (216) 831-5579

Cooper Lighting Group
400 Busse Rd., Elk Grove Village, IL 60007-2195
(847) 956-8400, fax: (847) 956-1475

Crouse-Hinds Co.
Lighting Production Div., P.O. Box 4999, Syracuse, NY 13221
(315) 477-8185

Doane, L.C., Co.
55 Plains Rd., P.O. Box 975, Essex, CT 06428
(203) 767-8295, fax: (203) 767-1397

Duro-Test Corp.
9 Law Dr., Fairfield, NJ 07004
(201) 808-1800, fax: (201) 808-6622

Federal APD, Inc., Federal Signal Corp.
24700 Crestview Ct., Farmington Hills, MI 48335
(800) 521-9330, (810) 477-2700, fax: (810) 477-0742

Gardco Lighting
2661 Alvarado St., San Leandro, CA 94577
(510) 357-6900, fax: (510) 357-3088

G.E. Company
3135 Easton Turnpike, Fairfield, CT 06431
(800) 626-2004, fax: (518) 869-2828

Hapco Div. of Kearney-National, Inc.
P.O. Box 547-KN, Abingdon, VA 24210
(540) 628-7171, fax: (540) 628-7707

Litetronics International
4101 W. 123rd St.,Alsip, IL 60658
(708) 389-8000 ext 195, fax: (708) 371-0627

Mason, L.E., Co.
98 Business St., Boston, MA 02136
(617) 361-1710, fax: (617) 361-6876

Philips Lighting Co.
200 Franklin Sq. Dr., Somerset, NJ 08875
(908) 563-3000, (800) 631-1259, fax: (908) 563-3975

Rig-A-Light
P.O. Box 12942, Houston, TX 77217
(713) 943-0340, fax: (713) 943-8354

Sterner Lighting Systems
351 Lewis Ave.,Winisted, MN 55395
(320) 485-2141, fax: (320) 485- 2899

Thomas and Betts
Corporate Headquarters, Memphis, TN 38119
(800) 888-0211, fax: (800) 888-1366

Unique Solution/Manville
515 McKinley Ave., Newark, OH 43055
(614) 349-4194, fax: (800) 346-5923

Foodservice Equipment

Equipment Suppliers

FlashBake Oven

Quadlux, Inc.
47817 Fremont Blvd., Fremont, CA 94538
(800) 843-6836, fax: (510) 498-4224

Induction Cooktop

CookTek Inc.
954 W. Washington MC37, Chicago, IL 60607
(800) 908-0004, fax: (888) 266-5329

Garland Commercial Industries
185 E. South St., Freeland, PA 18224
(800) 424-2411, fax: (717) 636-3903

Vulcan-Hart Co.
P.O. Box 696, Louisville, KY 40201
(800) 814-2028, fax: (502) 775-4053

Combination Oven-Steamer

Alto-Shaam, Inc.
W164 N9221 Water St., Menomonee Falls, WI 53051
(800) 558-8744, fax: (800) 329-8744

Blodgett Combi
P.O. Box 1440, Williston, VT 05495-1440
(888) 992-6624, fax: (802) 860-3784

Groen
1900 Pratt Blvd., Elk Grove Village, IL 60007
(847) 439-2400, fax: (847) 439-6018

Solid-State Electric Fryer

Frymaster Corporation
P.O. Box 51000, Shrieveport, LA 71135-1000
(800) 221-4583, fax: (318) 868-5987

Purified-Water Vending Machines

Equipment Suppliers

Pure Fill Corporation
501 Primo Way, Modesto, CA 95358
(209) 531-9120, fax: (209) 538-6112

Telewave, Inc.
99F Main St., Suite 300, Stoneham, MA 02180
(617) 292-5205, fax: (617) 331-2340

The Good Water Company
2961 Sudderth Ave., Ruidoso, NM 88345
(505) 257-3629, fax: (505) 257-2797

Information on Efficiency Technologies

This list provides EPRI resources on efficiency technologies identified in this guidebook. Copies of these publications can be ordered through the EPRI Distribution Center, (510) 934-4212.

Energy-Efficient HVAC

Unitary Thermal Energy Storage System Performance, TR-106729, July 1996.

Electric Chiller Handbook, TR-105951, February 1996.

Space-Conditioning System Selection Guide, TR-103329, December 1993.

Packaged Terminal Heat Pump Assessment Study, CU-6777, March 1990.

Additional information on HVAC can be obtained from the EPRI HVAC&R Center, (800) 858-3774.

Energy-Efficient Lighting

Proceedings—Efficient Lighting 1993: A Lighting Symposium for Electric Utility Lighting and DSM Professionals, TR-105963, January 1996.

Electronic Ballasts, BR-101886, May 1993.

High-Intensity Discharge Lighting, BR-101739, May 1993.

Advanced Lighting Technologies Application Guidelines: 1990, TR-101022-R1, May 1993.

Lighting Fundamentals Handbook, TR-101710, March 1993.

Commercial Lighting Efficiency Resource Book, CU-7427, September 1991.

Additional information on lighting can be obtained from the EPRI Lighting Information Office, (800) 525-8555.

Refrigeration

Dehumidification Performance of Air Conditioning Systems in Supermarkets: Field Demonstration with Heat Pipe Heat Exchangers in Delchamps Supermarket, Gulf Breeze, Florida, TR-106065, May 1996.

Characteristics and Energy Use of the Convenience Store Industry, TR-103982, May 1994.

Assessment of Refrigerated Display Cases, TR-103981, May 1994.

Field Testing of High-Efficiency Supermarket Refrigeration Systems, TR-100351, December 1992.

Analysis of Supermarket Dehumidification Alternatives, TR-100352, November 1992.

Guide for the Selection of Supermarket Refrigeration Systems, CU-6740, March 1990.

Additional information on refrigeration and dehumidification can be obtained from the EPRI HVAC&R Center, (800) 858-3774.

Trade Associations

Food Business Forum
3800 Moore Place, Alexandria, VA 22305
(703) 549-4525, fax: (703) 549-0406

Provides management research on problems related to food distribution and serves as a forum where food chain-store executives can exchange ideas and information.

Food Marketing Institute
800 Connecticut Ave., N.W. Washington, DC 20006
(202) 452-8444, fax: (202) 429-4529

Members are food retailers/wholesalers.

National Grocers Association
1825 Samuel Morse Dr., Reston, VA 22090-5317
(703) 437-5300, fax: (703) 437-7768

Members are independent retailers and regional wholesalers.

National Association of Convenience Stores
1605 King St., Alexandria, VA 22314-2792
(703) 684-3600, fax: (703) 836-4564

Members are retail food stores carrying a more limited selection than supermarkets and usually open longer hours.

Refrigerated Foods Association
2971 Flowers Rd. South, Suite 266, Atlanta, GA 30341
(404) 452-0660, fax: (404) 455-3879

Members are concerned with the manufacture and sale of refrigerated foods