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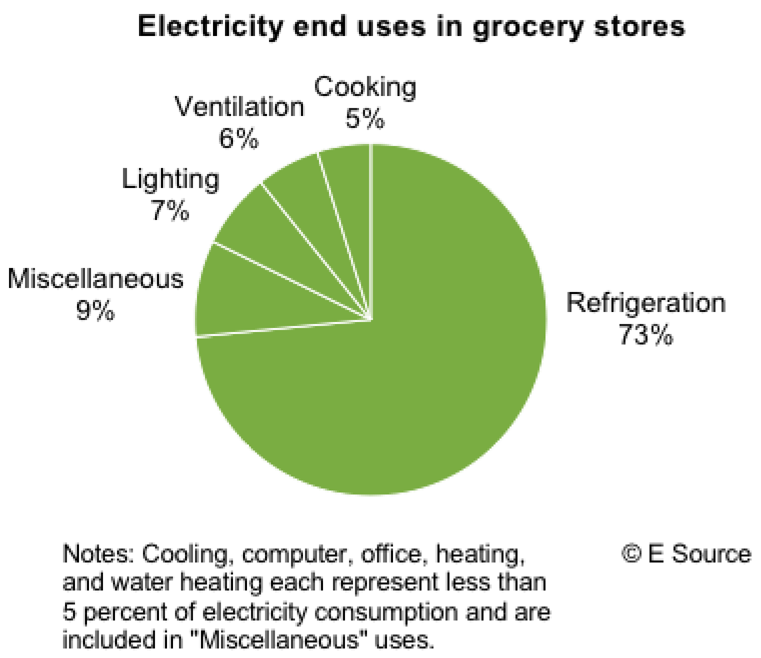
Grocery Stores

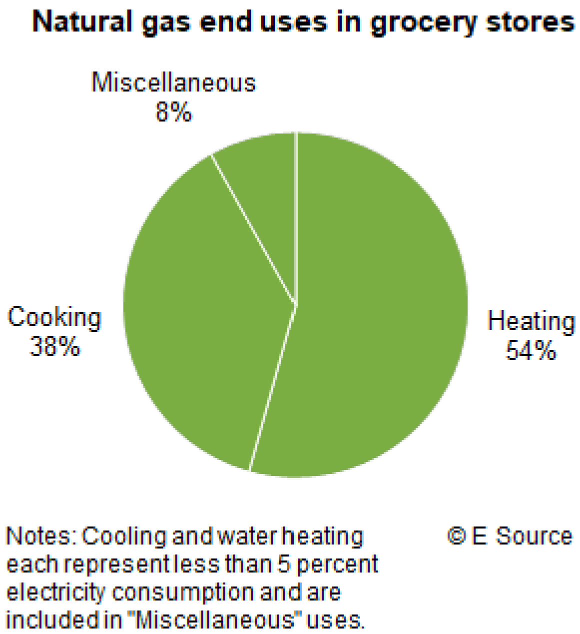
Grocery stores in the US use an average of 52.5 kilowatt-hours (kWh) of electricity and 38,000 Btu of natural gas per square foot annually. In a typical grocery, refrigeration and lighting represent about 65 percent of total use (**Figure 1**), making these systems the best targets for energy savings. Energy costs can account for up to 15 percent of a grocery store's operating budget. Because grocery stores' profit margins are so thin—on the order of 1 percent—every dollar in energy savings is equivalent to increasing sales by $59.

Average energy use data

Figure 1: Energy consumption by end use

In grocery stores, refrigeration and lighting are the bulk end uses for electricity; space heating and cooking dominate natural gas use.





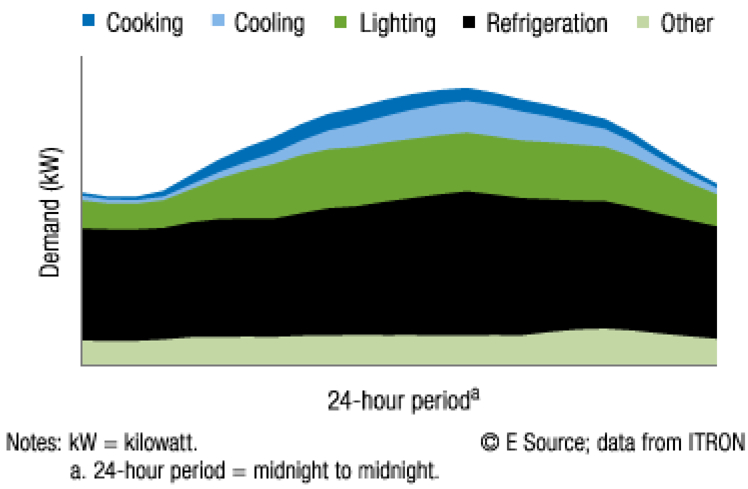
Top technology uses

- Heating
- Cooking
- Refrigeration

You'll be better able to manage your store's energy costs if you understand how you're charged for energy. Most utilities charge commercial buildings for their natural gas based on the amount of energy delivered. Electricity, on the other hand, can be charged based on two measures—consumption and demand (**Figure 2**). The consumption component of the bill is based on how much electricity, in kWh, the building consumes during a month. The demand component is the peak demand, in kilowatts (kW), occurring within the month or, for some utilities, during the previous 12 months. Monthly demand charges can range from a few dollars per kW to upwards of $20/kW. Peak demand can be a considerable percentage of your bill, so care should be taken to reduce it whenever possible. As you read these energy cost management recommendations, keep in mind how each one will affect both your consumption and your demand.

Figure 2: Diagram of a hypothetical daily load shape

Energy-efficiency measures reduce consumption and lower monthly peak demand charges.



QUICK FIXES

this section

Many grocery stores can benefit from low- or no-cost reductions in energy expenditures.

Turning things off

It's the simplest of ideas, and it doesn't require much more than staff training. Remember that every 1,000 kWh you save by turning things off equals $100 off your utility bill (assuming average electricity costs of 10 cents/kWh).

Plugged-in devices. Computers, cash registers, bar-code readers, deli scales, and deli cooking equipment should be shut off when not in use. Smart power strips that have built-in occupancy sensors can shut off plugged-in devices after a set interval of inactivity.

Lights. Turn off lights when they're not in use. Occupancy sensors can serve as a low-cost, easy-to-implement solution. Install them in some of the many rooms that aren't constantly in use, such as bathrooms, maintenance closets, offices, walk-in freezers, and storerooms. Stores that are open all night may want to install dual-level switching for overhead lights, allowing some fixtures to be turned off during low-traffic hours.

Turning things down

Some equipment can't be turned off entirely, but turning it down to minimum levels where possible can save energy.

HVAC temperature setbacks. During closed hours, turn temperature settings down in warming seasons and up in cooling seasons.

Special-use rooms. Make sure that HVAC settings in warehouses , stockrooms, offices, and other special-use rooms are at minimum settings.

Cleaning and maintenance

Check the economizer. Many air-conditioning systems use a dampered vent called an economizer to draw in cool outside air when it's available, which reduces the need for mechanically cooled air. The linkage on the damper, if it's not regularly checked, can seize up or break. An economizer that's stuck in the fully open position can add as much as 50 percent to a building's annual energy bill by allowing hot air in during the air-conditioning season and cold air in during the heating season. Have a licensed technician calibrate the controls; check, clean, and lubricate your economizer's linkage about once a year; and make repairs if necessary.

Check air-conditioning temperatures. With a thermometer, check the temperature of the return air going to your air conditioner. Then check the temperature of the air coming out of the register nearest the air-conditioning unit. If the temperature difference is less than 14° Fahrenheit (F) or more than 22°F, have a licensed technician inspect your air-conditioning unit.

Change filters. Change air-conditioner filters every month—more often if you're located next to a highway or construction site where the air is much dirtier.

Check cabinet panels and clean condenser and evaporator coils. On a quarterly basis, run a maintenance check on your rooftop air-conditioning unit . Make sure that the panels are fully attached, that all of their screws are in place, and that the gaskets are intact so no chilled air leaks out of the cabinet—such leaks can cost $100 per year per rooftop unit in wasted energy. In addition, check condenser coils quarterly and remove any debris, natural or otherwise, that has collected there. At the beginning and end of the cooling season, thoroughly wash the coils. The buildup of dirt and ice on evaporator coils slows down the rate of heat transfer and causes the refrigeration system to use more energy to maintain the same temperature. Cleaning cooling coils regularly helps ensure proper airflow and heat transfer, which can save up to 25 percent in operational costs and help prevent early compressor failure.

Check for airflow. Hold your hand up to air registers to ensure that airflow is adequate. If there is little airflow or dirt and dust are found at the register, have a technician inspect your unit and duct work.

Check the refrigerant charge. Incorrect refrigerant charge can compromise refrigeration equipment efficiency by 5 to 20 percent and raise the risk of early component failure. Have a licensed technician check the refrigerant charge of all refrigerated equipment annually.

Check refrigerated cases for air leakage. Every month, inspect and replace any worn seals and gaskets on the doors and inspect the door closers for proper operation.

Check temperature settings. Set refrigerator temperatures between 35° and 38°F and freezer temperatures between ?14° and ?8°F. Energy is wasted if refrigeration temperature settings drift too low, so check periodically to verify that the appropriate temperature settings are specified.

Add strip curtains to walk-ins. Walk-in units can lose a lot of cold air when doors are opened. In one case, simply adding strip curtains to the doors of a 240-square-foot walk-in refrigerator reduced the unit's energy consumption by 3,730 kWh per year—about 9 percent of total consumption. It's important to note that, for the best effect, strip curtains must reach the floor to catch the coldest air.

Replace incandescent lightbulbs with screw-in CFLs or LEDs. Wherever an incandescent lightbulb is installed that's on for longer than two hours per day, replace it with a CFL or, better yet, an LED . These lower-energy options are three to five times more energy efficient than incandescent bulbs, last at least 10 times as long, and—because they give off a minimum of one-third as much waste heat—reduce the loads on the store's cooling equipment. For freezer applications, specify low-temperature-rated CFLs or choose LEDs, which work well in cold conditions.

Install occupancy sensors in walk-ins. By replacing light switches with low-temperature occupancy sensors, you'll reduce lighting energy consumption by about half.

LONGER-TERM SOLUTIONS

this section

Although the actions described in this section require more extensive implementation, they can dramatically increase the efficiency of your store. Ask your local utility for more information about initiating such projects.

Optimize refrigeration

The optimization of refrigeration systems can reduce energy use by 24 percent relative to standard practice. The following measures yield the largest savings.

Floating head pressure. Taking advantage of lower ambient temperatures to reduce refrigerant temperatures is a form of free cooling. One approach is to allow the pressure of the vapor coming out of the compressor (the "head pressure") to float—that is, to drop with reduced ambient temperatures. This requires an expansion valve capable of operating at lower pressures and flow rates, and such valves are now commercially available. In addition, refrigerant pressures must be kept high enough to avoid "flashing"—the unwanted vaporization of refrigerant. According to the Washington State University Energy Extension Office, floating head pressure savings generally range from 3 to 10 percent.

Ambient and mechanical subcooling. Reducing the temperature of liquid refrigerant below its condensation temperature is called subcooling. This can be done either by using ambient air or water to remove heat from the liquid refrigerant (ambient subcooling) or by using an additional refrigeration system (mechanical subcooling). Colder refrigerant means either more cooling per pound of refrigerant delivered to the display case or shorter compressor run times because less refrigerant is needed, both of which can decrease energy use. Ambient subcooling is often more cost-effective than mechanical subcooling because it requires less equipment.

Evaporative condensers. Most condensers in grocery stores are air-cooled, but it's also possible to use evaporative condensers, which are cooled by water spraying over the condensing coils. Evaporative condensers are more energy efficient than their air-cooled counterparts, but they do have a notable disadvantage: They require a water supply, which often means increased maintenance due to freezing, clogging, and mineral buildup.

Evaporative condensers may be cost-effective in drier climates, but the added maintenance may make them unattractive in other climates.

Heat-recovery systems. Heat-recovery systems are available that capture waste heat from refrigeration equipment to make hot water for use in the store. Heat recovered from a 7.5-horsepower compressor can heat all of the hot water a midsize supermarket would use in its kitchens and bathrooms. Often, enough waste heat is also available to supply hot water coils for space heating in cold weather.

Display case shields. Aluminum display-case shields can reduce refrigeration load from the display case by 8 percent when applied overnight and by 40 percent when applied over a 24-hour holiday, relative to the load present without the shield. Products are kept colder when the shields are attached and remain colder for several hours after the shields are removed.

Evaporator-fan motors. Replacing existing shaded pole motors on evaporator fans with electronically commutated motors will reduce the energy consumption of refrigerator and freezer cases by up to one-third. Drop-in replacement designs have made this retrofit relatively simple for a technician to perform. Additionally, most evaporator-fan motors in walk-in units run continuously even though full airflow is usually required only about half the time. Consider introducing advanced controllers that slow the fans when full-speed operation is unnecessary. Annual energy savings from adding walk-in cooler controllers can range from 10 to 60 percent.

Anti-sweat heater controls. The latest anti-sweat heater controls sense humidity in the store’s ambient air and reduce the operation of their heaters in low-humidity conditions. They promise significant savings and quick payback, and they are relatively easy to install. Savings can be in the 6 percent to 20 percent range, according to the Washington State Energy Solutions Database.

Smart defrost controllers. When installed in walk-in freezers, a smart defrost controller monitors several variables and optimizes the number of daily defrost cycles. Adding these kits can save hundreds of dollars a year per freezer, compared to conventional defrosting practices, depending on the size of the freezer.

Automatic doors for walk-in coolers. In addition to adding strip curtains to walk-in coolers, automatic doors can provide even greater energy savings, though at a higher cost.

Consider combined heat and power

Combined heat and power (CHP) plants generate electricity at the point of use and allow the heat that would normally be lost in the power generation process to be recovered to provide necessary heating and cooling. CHP plants can power store equipment and provide backup power generation when grid power is unavailable, which serves to prevent product loss; they can also provide hot water and auxiliary cooling for the facility. In one example, a Whole Foods store in Brooklyn, New York, installed a 157-kW CHP plant to power chillers, provide hot water, and provide power in the event of a power outage. Read more about the steps this store took in the SustainableBusiness.com article Whole Foods Brooklyn Store Is Most Innovative Yet.

Consider desiccant dehumidification

In humid climates, much of the energy used in air conditioning goes to removing moisture from the air. Desiccant dehumidification can be a cost-effective solution for removing this moisture because it uses natural gas instead of electricity. In some cases, air-conditioning equipment can be smaller because it only gets used to cool dry air.

Upgrade to more efficient lighting

Lighting is critical to creating ambiance and making merchandise attractive to shoppers. High-quality lighting design can reduce energy bills and drive sales. If your facility uses T12 fluorescent lamps, relamping with high-performance T8 lamps and electronic ballasts can reduce your lighting energy consumption by 35 percent. Adding specular reflectors and new lenses and reducing the number of lamps can double the savings. Occupancy sensors or timers can add further savings in areas that aren’t highly trafficked, and payback periods of one to three years are common. LEDs can provide even greater savings: Fluorescent fixtures can be replaced with LED fixtures, LED retrofit kits, or LED tubes. New fixtures are the most efficient alternative; LED tubes are the easiest, but they may not provide adequate light levels or light distribution.

Refrigerated display case lighting. The efficiency of LEDs improves in cold operating environments (unlike linear fluorescent systems, the light output of which drops in low temperatures). LEDs are also directional in nature, allowing for less wasted light. As a result, LED case lighting can cut lighting energy use by more than 40 percent compared to T8 fluorescent lamps.

LEDs can also be tied to occupancy sensors so that the cases are only illuminated when shoppers are present. This is a particularly easy savings opportunity for supermarkets that remain open 24 hours a day. When Walmart initiated a pilot LED program integrating occupancy sensors into its LED display lighting, the company estimated the total time lights were on would drop from 24 to 15 hours per day—a 38 percent reduction. Occupancy sensors aren't typically used for cases that are illuminated by fluorescent lighting because frequent switching reduces the life of fluorescent lamps, but it has no impact on LEDs. This approach also lengthens the life of LEDs—the more time the LEDs spend turned off, the longer the lamps will last.

The use of LEDs also reduces case compressor loads. Because the cases can use lower-wattage lamps, there's less heat to dissipate. Additionally, the heat sink for an LED can be positioned to allow at least some of the heat to dissipate outside the case. With fluorescent lighting, most of the waste heat must be offset with additional cooling inside the case. When LEDs are used with occupancy sensors, they'll spend less time in the on mode and therefore contribute less to the cooling load. LEDs also provide more even light distribution, can be dimmed, have a very long lifetime, and have been shown to appeal to shoppers at significantly greater rates than linear fluorescent lighting.

Use smart lighting design in parking lots

Reduce light levels. Parking lots are often overlit—an average of 1 foot-candle of light (sometimes less) is usually sufficient. Dimming and occupancy-sensing controls can also add to energy savings in parking lots.

Install more efficient light sources. The most common lamps used for outdoor lighting are high-intensity discharge (HID) sources —metal halide and high-pressure sodium (HPS). Fluorescent and induction lamps are also used in parking lots, but LEDs have become the most efficient alternative as their performance has improved and prices have come down.

LEDs can be a good choice for parking lots because the fixtures perform well in the cooler conditions that are typically found outside at night, and because LEDs work better with controls than HID products do. LEDs also offer long life (which reduces maintenance costs), they provide more even light distribution, and they produce less light pollution and light trespass—properties that improve aesthetics and contribute to energy savings. For example, in recent field testing, the US Department of Energy (DOE) found that LEDs had only somewhat higher efficacy than HPS lamps, but that LEDs provided substantial energy savings thanks to lower overall light levels enabled by better uniformity and less light pollution. The one downside is that users should be wary of the potential for glare. A parking lot retrofit of LEDs cut lighting energy use by 70 percent in the DOE-monitored Application Assessment of Bi-Level LED Parking Lot Lighting (PDF) at a Raley's Supermarket in California.

Consider reflective roof coating

Painting the roof of a grocery store with white or other highly reflective paint can reduce the energy required for summer cooling by 25 to 65 percent and help trim peak demand, as well as increase the life of the roof. The US Environmental Protection Agency has a list of suitable reflective roof coating products.
