

Grocery stores and restaurants spend a large portion of their energy dollars on refrigeration – about 15 percent for a restaurant and more than 50 percent for a large grocery. Typical refrigeration energy costs for restaurants and grocery stores in the Phoenix area are shown in the table below.¹

Refrigeration Applications and Energy Savings Potential

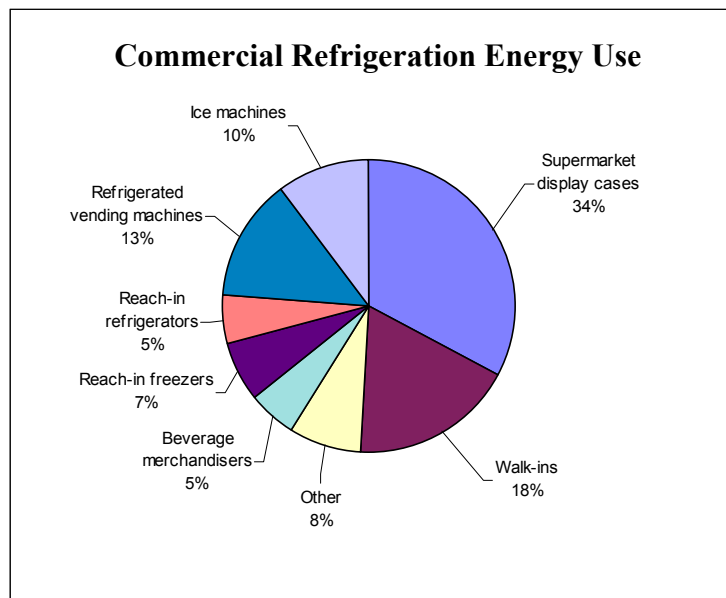
Refrigeration applications in the commercial sector involve a wide range of technologies from stand-alone residential-type refrigerators to large central supermarket refrigeration systems. The most common refrigeration applications include:

- **Grocery store refrigeration systems** – Grocery store systems have two distinct components: 1) the display cases, and 2) the central refrigeration system including mechanical equipment and controls. Grocery stores account for about one third of refrigeration energy use.
- **Beverage merchandisers** – Beverage merchandisers consume about five percent of overall refrigeration energy.
- **Reach-in refrigerators and freezers** – Reach-in refrigerators and freezers account for about 12 percent of refrigeration energy use overall.
- **Refrigerated vending machines** – Refrigerated vending machines consume about 13 percent of commercial sector refrigeration energy use.
- **Walk-in coolers and freezers** – Walk-in coolers and freezers account for about 18 percent of refrigeration energy use.
- **Ice machines** – Ice making accounts for about 10 percent of refrigeration energy use.
- **Other applications** – Commercial refrigeration also includes a wide range of other miscellaneous applications including water coolers, non-beverage merchandisers and residential grade refrigerator/freezer combinations. This segment of the market uses about eight percent of refrigeration energy use.

Annual Refrigeration Electricity Cost

Facility Type	Annual Cost Per Square Foot
Sit-down Restaurant	\$0.46
Fast-service Restaurant	\$1.04
Small Grocery	\$1.42
Large Grocery	\$2.20

Commercial Refrigeration Energy Use



The chart presents a breakdown of energy use in the commercial sector for these refrigeration applications. Significant opportunities exist for energy efficiency improvements in commercial refrigeration. Estimates of the overall cost-effective energy savings potential for each of these technologies are provided in the following table. The savings

¹ APS study of energy use in commercial buildings in the Phoenix area.

potential estimate is for a combination of energy efficiency improvements for each technology with payback in five years or less.²

Cost-effective Refrigeration Energy Savings Potential

Technology	Energy Savings Potential
Grocery store systems	14%
Beverage merchandisers	45%
Reach-in refrigerators	50%
Reach-in freezers	40%
Refrigerated vending machines	42%
Walk-in coolers and freezers	32%
Ice machines	20%

Refrigeration Energy Efficiency Measures

Opportunities for saving energy and reducing energy costs for refrigeration systems will depend on the particular application. The table below shows the application of selected energy efficiency measures to different refrigeration technologies. A brief description of each opportunity is included below.

Refrigeration Energy Efficiency Measures

Energy Efficiency Measure	Grocery display cases and systems	Beverage merchandisers	Reach-in freezers	Reach-in refrigerators	Refrigerated vending machines	Walk-in coolers and freezers	Ice machines
High-efficiency evaporator fan motors	✓	✓	✓	✓	✓	✓	✓
High-efficiency condenser fan motors	✓	✓	✓	✓	✓	✓	✓
High-efficiency compressor systems	✓	✓	✓	✓	✓	✓	✓
Floating head pressure controls	✓					✓	
Liquid pressure amplifiers	✓					✓	
Anti-sweat heater controls	✓		✓	✓		✓	
Defrost controls	✓		✓			✓	
Evaporative condensers	✓						
Ambient subcooling	✓					✓	
Mechanical subcooling	✓						
Heat recovery	✓						
Energy-efficient reach-ins			✓	✓			
Add doors to display cases	✓						
Efficient lighting	✓	✓	✓	✓	✓	✓	

High-efficiency evaporator fan motors – These small fans are typically less than one-tenth of a horsepower. A grocery store can have hundreds of them, so their energy consumption can be significant. Specifying high-efficiency motors for evaporator fans is almost always a good investment, and they can also be implemented on a retrofit basis. Energy savings are estimated to be about 2 percent of refrigeration system electricity use for reach-in freezers, 7 percent for reach-in

² *Energy Savings Potential for Commercial Refrigeration Equipment*, U.S. DOE, 1996.



refrigerators, 8 percent for grocery store display cases, 5 percent for ice machines, 14 percent for vending machines, and 29 percent for beverage merchandisers.³

High-efficiency condenser fan motors – Specifying high-efficiency motors on condenser fans is also a good idea. System energy savings estimates are in the 3 to 5 percent range.

High-efficiency compressor systems – Energy savings potential for high-efficiency compressors are estimated to be 6 percent for ice machines, 9 percent for vending machines and beverage merchandisers, 12 percent for reach-in refrigerators, and 16 percent for reach-in freezers.

Floating head pressure controls – Floating head pressure controls allow compressor head pressures to vary with outdoor conditions. This saves energy dollars and helps refrigeration equipment to last longer. Floating head pressure controls are often standard features on new systems; however, they can be retrofitted as well. Estimated savings range from three to 10 percent for grocery store systems.

Liquid pressure amplifiers – Liquid pressure amplifiers are small refrigerant pumps that raise liquid line pressure to increase system efficiency. For systems with air-cooled condensers, the lower the outdoor air temperature, the greater the efficiency gain. Energy savings can be up to 20 percent⁴.

Anti-sweat heater controls – Anti-sweat heaters are electric heaters installed in virtually all low temperature and many medium temperature display cases to keep their external surfaces free of condensation during high humidity conditions. Typically they are on all the time. Anti-sweat heater controls sense store humidity conditions and turn the heaters off when they are not needed. Energy savings estimates range from about six percent for grocery store display cases to 14 percent for reach-in freezers and 20 percent for reach-in refrigerators.

Defrost controls – Energy-efficient defrost systems improve the operation of the defrost cycle. The most effective controls are called demand controls which initiate defrosting in a variety of ways such as measuring the temperature or pressure drop across the evaporator, measuring frost accumulation and sensing humidity. All of these methods, if used properly, are more effective than using a simple timer clock to initiate defrosting. Energy savings estimates range from about one percent to six percent of refrigeration system energy use.

Evaporative condensers – Most refrigeration systems use air-cooled condensers to expel heat. Evaporative condensers use a wetted filter to cool ambient air as it enters the condenser increasing its ability to reject heat. Energy savings estimates range from about three percent to nine percent for grocery store refrigeration systems.

Ambient subcooling – Ambient subcooling involves the use of an oversized condenser or an additional heat exchanger to subcool liquid refrigerant. Savings estimates range from about one percent for grocery store systems to about nine percent for walk-in coolers.

Mechanical subcooling – Mechanical subcooling is an effective method of cooling liquid refrigerant below its saturation pressure in order to increase system capacity and improve efficiency. Energy savings are estimated to be as much as 25 percent for grocery store refrigeration systems.

Heat recovery – Heat recovery systems use heat removed from display cases to heat water. The amount of water that can be heated will depend on the situation. However, a 7.5 hp compressor can supply close to 100 percent⁵ of the hot water requirements in a medium-sized grocery store all year long.

Energy-efficient case lighting – T-8 fluorescent lamps and electronic ballasts are often used in new energy-efficient cases and can be retrofitted in existing cases as well. These high efficiency fixtures reduce lighting energy use and reduce the cooling load on the compressor. Energy savings potential is estimated to be about 10 percent for beverage merchandisers.

Add doors to display cases – Glass doors on open multi-deck display cases can reduce compressor energy costs, reduce cold air spillage and increase store comfort conditions. Doors can often be added to existing cases as a retrofit. Savings are estimated to be as high as 50 percent, and paybacks will typically be in the range of one to two years for retrofits.⁶ However, installing doors can cause the compressor system to be oversized so be sure to get assistance from a refrigeration professional when conducting a retrofit.

³ *Energy Savings Potential for Commercial Refrigeration Equipment*, U.S. DOE, 1996.

⁴ Source: HY-SAVE Inc.

⁵ Source: The Commercial Refrigerator Manufacturers Association's "Recommended Guidelines for Retail Food Store Design", 1/79

⁶ Source: Energy saving data in this paragraph taken from PG&E Application Note No. 53-43-82, 1982

Energy-efficient reach-in refrigerators – When purchasing a new residential-grade refrigerator look for equipment with the EPA’s Energy Star® logo. Units that have earned the Energy Star logo use at least 30 percent less energy than required by federal government standards. Side-by-side refrigerator/freezers use significantly more energy than those with the freezer above the refrigerator. Use the EnergyGuide label on new refrigerators to select the most efficient model.

Operating and maintenance efficiency measures – Operating and maintenance practices can also significantly improve the efficiency of refrigeration systems. Clean cooling coils several times a year and make sure outdoor coils are shaded from the sun and have good air circulation around them. Make sure the doors on your freezers, refrigerators and display cases seal tightly, and repair any damaged door seals.

For More Information on Energy-efficient Refrigeration Systems

Check out the Web sites of the Association of Energy Engineers, the U.S. Department of Energy’s Energy Efficiency and Renewable Energy Network (EREN), the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc (ASHRAE), the Air-Conditioning & Refrigeration Institute (ARI), the Commercial Refrigerator Manufacturers Association and the American Council for an Energy-Efficient Economy (ACEEE).

For general information regarding electric service for your business, call the APS Business Center at 602-371-6767 or 1-800-253-9407. For an online analysis of your business energy use visit the APS Web site and take the Energy Survey at http://www.aps.com/aps_services/energysurvey/Default_BUSRES.html?type=b.