

Improving Energy Efficiency in Commercial Kitchens



Commercial kitchens, found in restaurants and hospitality and institutional facilities, are intense energy users, putting food service facilities among the biggest energy consumers per square foot of all commercial buildings. In a typical food service facility, food preparation, water heating, and refrigeration combined represent nearly 60 percent of total energy use, making those systems excellent targets for energy savings (see **Figure 1**). Kitchen ventilation systems also present sizable opportunities for energy savings, accounting for up to 75 percent of the HVAC load.

Energy-Efficient Solutions

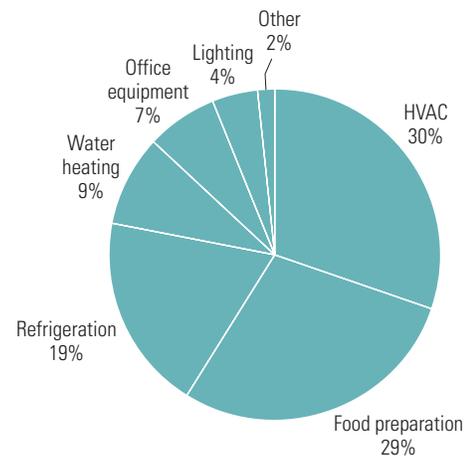
Improving the efficiency of commercial kitchen equipment can result in savings of 10 to 30 percent, depending upon the technologies installed. Keeping equipment clean and making operational changes can also be easy and low-cost ways to save a significant amount of energy.

Food Preparation

Purchase high-efficiency equipment. Substantial energy savings are achievable through replacing conventional equipment (see **Table 1**, next page) with Energy Star-qualified products, which are often 15 to 30 percent more energy efficient than standard equipment, or other high-efficiency equipment if Energy Star specifications don't exist. In the latter case, contact the Pacific Gas and Electric Co. Food Service Technology Center for a list of high-efficiency equipment models. This measure is best applied when equipment is at the end of its usable life because of the capital investment required (with the exception of steam cookers, which may warrant early replacement due to high energy savings).

Turn off unused equipment. Equipment not in use wastes a significant amount of energy in commercial kitchens every year (see **Table 2**, next page).

Figure 1: Energy consumption by end use in food service facilities



Source: E SOURCE; data from U.S. Energy Information Administration

Check oven and steamer seals. To keep heat from escaping, it is important to make sure the seals around the doors are in good shape and create a proper seal.

Keep equipment clean. Cleaning equipment can make it operate more efficiently and extend its life. For example, sediment in the bottom of a fryer can reduce its efficiency, and debris at the bottom of an oven can prevent the door from sealing well.

Ventilation

Specify effective exhaust hoods. Hood style impacts energy use because it affects the design exhaust rate. The proximity-style (backshelf) hood requires the least exhaust air and is therefore the most efficient, followed by the wall-mounted canopy hood and single-island canopy hood, respectively.

To reduce the design exhaust rate for any hood, install end panels and specify hoods that have a lip along the leading edge. Also, choose Underwriters Laboratory-Listed hoods because they typically require lower exhaust flows than unlisted hoods. Group

Table 1: Annual energy costs and savings for conventional versus high-efficiency food preparation equipment

	Gas							
	Annual energy use (therms)		Energy cost (\$)		Savings (therms)	Energy savings (\$)	Total savings including water (\$)	Simple payback of initial additional cost (years)
	Conventional	High efficiency	Conventional	High efficiency				
Convection oven ^a	1,052	728	1,091	755	324	336	336	NA
Combination oven ^{b, c}	1,532	1,129	1,589	1,171	403	418	782	NA
Fryer ^d	1,305	901	1,353	934	404	419	419	2.4
Steam cooker ^{c, d}	735	396	762	411	339	352	1059	0.0
Griddle ^e	1,118	1,060	1,159	1,099	58	60	60	NA

	Electric							
	Annual energy use (kWh)		Energy Cost (\$)		Savings (kWh)	Energy savings (\$)	Total savings including water (\$)	Simple payback of initial additional cost (years)
	Conventional	High efficiency	Conventional	High efficiency				
Convection oven ^a	12,193	9,931	1,061	864	2,262	197	197	NA
Combination oven ^{b, c}	38,561	20,130	3,355	1,751	18,431	1,603	1,967	NA
Fryer ^d	14,585	13,860	1,269	1,206	725	63	63	7.9
Hot food holding cabinet ^d	9,855	3,154	857	274	6,701	583	583	2.1
Steam cooker ^{c, d}	7,868	4,120	685	358	3,748	326	1,032	0.0
Griddle ^e	17,315	15,684	1,506	1,365	1,631	142	142	NA

Notes: Energy rates used are \$1.037/therm and \$0.087/kWh. Although gas prices are relatively even across North America, electricity prices vary greatly, so it may be necessary to recalculate savings using local rates. Water rate used is \$4.158/1,000 gallons. All money figures are in U.S. dollars. NA = not available.

Source: E SOURCE; data from Energy Star and Food Service Technology Center

- a. High-efficiency convection ovens include electric models with cooking energy efficiencies of 70 percent or greater and gas models with cooking energy efficiencies of 40 percent or greater.
- b. High-efficiency combination ovens include electric models with cooking energy efficiencies of 60 percent or greater and gas models with cooking energy efficiencies of 40 percent or greater.
- c. Significant cold water savings achieved with efficient models increase cost savings.
- d. High-efficiency equipment is Energy Star qualified.
- e. High-efficiency griddles include electric units with cooking energy efficiencies of 70 percent or greater and gas units with cooking energy efficiencies of 38 percent or greater.

Table 2: Turning off unused equipment saves energy

	Annual savings possible	
Turning off unused gas burners	100 therms	\$100
Turning off unused electric burners	1,000 kWh	\$90
Turning off gas underfired broiler, 1 hour per day	360 therms	\$370
Turning off electric broiler, 1 hour per day	3,600 kWh	\$310

Note: Energy rates used are \$1.037/therm and \$0.087/kWh. All money figures are in U.S. dollars.

Courtesy: Food Service Technology Center

heavy-duty appliances, such as charbroilers and ranges, under the center of the hood, and place ovens at the ends. Push appliances as far back under the hood as possible. For any type of hood, turning it off at night may save energy.

Use variable-speed hood controllers. Intelligent, variable-speed hood controller systems can significantly reduce energy costs in commercial kitchens. Standard kitchen exhaust hoods use single-speed fans and are left running at full speed throughout the kitchen's operating hours, even during idle periods.

A variable-speed hood controller uses a photoelectric smoke or heat detector to determine when and how much ventilation is needed and activates the exhaust fan at the proper speed. In appropriate applications, this technology yields a one- to two-year simple payback.

Introduce makeup air effectively. Depending on the layout of the space, an effective method for reducing the energy



costs associated with kitchen makeup air may be to pull makeup air from the dining room into the kitchen. That air must be supplied by the HVAC system to meet code requirements for ventilating the dining room. Using it in the kitchen as well reduces the total amount of makeup air required, thereby decreasing the fan power needed and the amount of air that must be conditioned.

When makeup air is introduced directly into the kitchen, discharging it downward starting from a low position on the wall behind the cooking appliances will least disturb the exhaust system's ability to capture and contain effluents. For makeup air introduction from the ceiling, use perforated plate diffusers and keep makeup air delivered near the hood at low velocity. Energy-efficient choices for makeup air conditioning include evaporative cooling and direct-fired heaters.

Refrigeration

Inspect refrigerator and freezer doors. To prevent leakage of cool air, replace worn gaskets and make sure doors are aligned properly. Also check that automatic door closers are functioning and strip curtains are not damaged.

Clean refrigerator coils regularly. Cleaning dirty air-conditioning and refrigeration (evaporator and condenser) coils can improve efficiency and help prevent early compressor failure.

Install evaporative fan controllers. In virtually all walk-in coolers and freezers, small or large, air is cooled by forced-circulation evaporators that contain propeller fans powered by fractional-horsepower motors. Typically, these fans run continuously even though, on average, full airflow is required only about half the time. Controllers are available that slow these fans when full-speed operation is unnecessary, saving 10 to 60 percent of overall refrigeration energy. Users report paybacks as short as one year.

Use efficient fan motors. For new walk-in refrigerators or freezers or those with failing fan motors, install or specify high-efficiency motors. A high-efficiency motor

in a walk-in will do exactly the same work as a standard-efficiency evaporator fan motor, yet the annual cost savings per motor can result in about a one-year payback for the total cost.

Purchase Energy Star solid-door refrigerators and freezers.

Energy Star-labeled commercial solid-door refrigerators and freezers can reduce energy consumption by as much as 45 percent, so purchasers can expect to save \$170 per refrigerator and \$120 per freezer annually (at an electricity rate of \$0.087/kWh). This results in a 1.0- to 1.2-year simple payback of the initial additional cost.

Water Heating

Use proper water heater settings and ensure that the distribution system is leak-free.

Set the water heater temperature to 140° Fahrenheit (F) (60° Celsius [C]), insulate hot water lines, regularly ensure that the water heater temperature/pressure-relief valve is operational, and fix any leaks.

Use low-flow sprayers for prewashing. Low-flow sprayers, which discharge hot water at a rate no greater than 1.6 gallons per minute, are used to remove food from dishes, utensils, pots, and pans before placing them in a dishwasher. At a cost of around \$60 per low-flow valve, the payback is often less than two months.

Use proper dishwasher setpoints and operation mode.

Set rinse pressure to 15 to 25 pounds per square inch (100 to 172 kilopascals) to avoid excess water use, set the wash-tank temperature to 160°F (71°C), and set the booster heater setpoint to 180°F (83°C) (in accordance with guidelines from NSF International, an organization that develops standards for public health and safety). Check that wash curtains for conveyor washers are not missing or too short to prevent heat from escaping. Also, run the dishwasher only when full; don't run it in manual mode, or the machine will likely run too long without automatic shutoffs; and turn off high-temperature dishwashers at night so that heating elements will not consume energy.

Purchase a high-water-efficiency dishwasher. High-efficiency dishwashers are distinguished by their low water consumption per rack for conveyer or door-type dishwashers (this may not apply to under-counter units). Purchasing or renting a dishwasher with an NSF water consumption rating of less than 1 gallon per rack (this rating is available on the NSF website, www.nsf.org) reduces the amount of water heating necessary. Low-temperature dishwashers use less energy than high-temperature units, but operating costs are about the same because of the cost of the sanitization chemicals required for low-temperature units. If a high-temperature dishwasher is chosen, consider installing a gas booster heater instead of electric—depending on local energy prices, energy cost savings often more than make up for increased capital and installation cost.

Best Practices

Create a maintenance calendar. Putting all the recommended maintenance dates for parts and equipment, including monthly, quarterly, semiannual, and annual checks, on a calendar will help to achieve maintenance goals. The calendar should include dates for calibrating thermostats on cooking and air-conditioning equipment, lubrication of exhaust- and supply-fan bearings, and changing air-conditioning equipment air filters.

Hire or contract a maintenance technician. A maintenance technician or consultant who specializes in food service equipment can ensure that a facility follows its maintenance schedule and will properly maintain complex equipment.

Educate staff. An inexpensive way to save energy is to simply inform staff about being conscious of energy use. Develop simple energy management procedures—with checklists—and assign responsibility between shifts and at the end of the day for turning off cooking equipment, exhaust fans, lights, computers, and other office equipment.

Useful Links and Contacts

Canadian Restaurant and Foodservices Association, www.crfa.ca.

Commercial Food Service Rebate Finder, www.energystar.gov/index.cfm?fuseaction=CFSrebate.CFSrebate_locator.

Energy Star, www.energystar.gov.

NSF International, www.nsf.org.

Pacific Gas and Electric Co. Food Service Technology Center, www.fishnick.com.

