Exchange Mainstreet Mall, Goodfellow Air Force Base, Texas. *Photo from U.S. Air Force, 17 TRW/PA*

The U.S. Department of Energy's (DOE) Federal Energy Management Program (FEMP) facilitates the Federal Government's implementation of sound, cost-effective energy management and investment practices to enhance the nation's energy security and environmental stewardship.

KITCHEN APPLIANCE UPGRADES IMPROVE WATER EFFICIENCY AT DOD EXCHANGE FACILITIES

Best Management Practice Case Study #11: Commercial Kitchen Equipment

Commercial kitchens are often forgotten when people begin to think about performing water audits. Kitchens can be out of sight, out of mind; a commercial kitchen, however, can consume large amounts of water and energy if inefficient appliances are installed. The Exchange, formerly the Army and Air Force Exchange Service (AAFES), is taking a leadership role in water efficiency improvements in their commercial kitchens by integrating water efficiency concepts into the organization's overall sustainability plan and objectives.

The Exchange is a joint military activity, the U.S. Department of Defense's (DOD) oldest and largest retailer. The Exchange provides merchandise and services to military personnel, operating more than 3,100 facilities worldwide in more than 30 countries, five U.S. territories, and 50 states. In addition to Mainstreet Malls, some of the facilities operated by the Exchange include convenience stores, specialty stores, and movie theaters, which are typically housed at Army and Air Force installations. The Exchange returns earnings to the Army and Air Force to improve troops' quality of life and to provide a dividend to support morale, welfare, recreation, and services programs. Exchange earnings also help to build new or upgrade existing facilities.

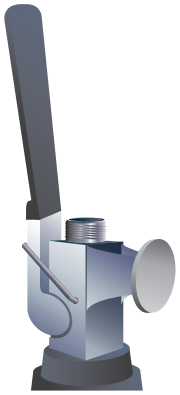
LEED Silver (pending) shopping center food court, Fort Bliss, Texas. *Photo from U.S. Army*

The Exchange has developed a new sustainability policy with the long term goal of improving the energy and water efficiency of Exchange facilities. One of the core components of the sustainability plan is the procurement of efficient equipment and fixtures that can be incorporated into the renovation of an existing facility or in a new construction facility. For these efforts, the U.S. Department of Energy's (DOE) Federal Energy Management Program (FEMP) has awarded the Exchange with a Federal Energy and Water Management Award for Programs that Implement Efficient Energy, Water, and /or Fleet Management for the Exchange's work in incorporating sustainable actions into normal business practices across all aspects of the Exchange's organization. Between fiscal year (FY) 2008 and 2009, the Exchange has reduced its consumption of water by 5.4% or 24,000 gallons and electricity by 70 billion British thermal units (Btu), equaling $2.7 million in costs.

This case study centers on the aspects of the Exchange's sustainability plan that incorporate high efficiency commercial kitchen equipment including pre-rinse spray valves, commercial dishwashers, food steamers, and ice machines.

Pre-Rinse Spray Valves

Pre-rinse spray valves are typically used in a commercial kitchen to wash food debris from dishes prior to entering the dishwasher, which helps shorten dishwasher wash cycle run times. Pre-rinse spray valves are relatively inexpensive to install and typically offer very good economic reasons for replacement because of both energy and water savings.



Pre-rinse spray valve

The Exchange's sustainability plan calls for high efficiency pre-rinse spray valves—rated at 1.25 gallons per minute (gpm)—to be installed when facilities are built or renovated. This plan is based on a FEMP-designated product category energy efficiency requirements that require Federal agencies to purchase high efficiency pre-rinse spray valves.[1] Current standards for pre-rinse spray valves stipulate that the maximum flow rate is 1.6 gpm. Table 1 provides a comparison of current standard flow rates to the flow rate of the FEMP-designated pre-rinse spray valve and the estimated savings an installation would see using the FEMP-designated product category.

Table 1. Commercial Pre-Rinse Spray Valve Savings

Fixture	Current flow rate	FEMP specification	Water savings	Energy savings	Annual water savings	Annual energy savings
Pre-rinse spray valve	1.60 gpm	1.25 gpm	22%	23%	10.50 kilogallon (kgal)	60 therm

Commercial Dishwashers

The dishwasher is typically one of the biggest energy and water users in a commercial kitchen. There are two basic models of dishwashers, low-temperature and high-temperature. Low-temperature machines simply use the existing hot water supply (typically at 140°F) and a chemical sanitization for the final rinse cycle. High-temperature machines use a "booster heater" to sanitize dishes at 180°F.

Of these two basic models, there are four distinct types of commercial dishwashers: under-the-counter dishwashers; stationary rack, single tank, or door-type dishwashers; single tank conveyor dishwashers; and multiple tank conveyor dishwashers.

The Exchange's sustainability plan calls for replacing and installing ENERGY STAR® qualified dishwashers in its facilities. A standard model consumes between 1 and 2 gallons per rack (gpr) for all four types; ENERGY STAR qualified dishwashers must use less than 0.54 and 1.70 gpr, depending on the model. Some of the higher efficiency dishwashers store and recycle the final rinse water and use it in the first wash cycle of the next round of dishes. Table 2 details the different types of commercial dishwashers, showing the savings between a standard and ENERGY STAR qualified model.

Commercial dishwasher

Table 2. Commercial Dishwasher Savings

Dishwasher	Standard consumption (gpr)	ENERGY STAR consumption (gpr)	Estimated annual water savings[a] (gal)	Estimated annual energy savings (kWh)*
Under the counter, high-temperature water	1.98	1.00	76,440	13,546
Under the counter, low-temperature water	1.95	1.70	19,500	3,456
Stationary rack, single tank, door type, high-temperature water	1.44	0.95	38,220	6,924
Stationary rack, single tank, door type, low-temperature water	1.85	1.18	52,260	9,261
Conveyor with single water tank, high-temperature water	1.13	0.70	33,540	7,231
Conveyor with single water tank, low-temperature water	1.23	0.79	34,320	6,082
Conveyor with multiple water tanks, high-temperature water	1.10	0.54	43,680	7,741
Conveyor with multiple water tanks, low-temperature water	0.99	0.54	35,100	6,220

[a]Dishwasher operated 260 days per year and 300 racks per day

[1] FEMP-designated product category: pre-rinse spray valves: *www.femp.energy.gov/technologies/eep_low-flow_valves.html*

Commercial Food Steamers

Food steamers provide fast, high-volume cooking by injecting steam into a large oven-style compartment, transferring heat from the steam to the food. Two common types of steamers are boiler-based and connectionless steamers. Boiler-based steamers are connected to a boiler that injects steam into the food compartment. Steam and hot condensate that is not taken up in the food drains to the bottom of the equipment and often needs to be tempered with additional water before it is rejected into the sewer line. Average water rates for boiler-based steamers, whether fueled by electricity or gas, are 40 gallons per hour (gph).

The Exchange's sustainability plan calls for installing a connectionless ENERGY STAR qualified steamer. These units have a water reservoir that is heated to supply steam to the food. A small amount of the steam is vented, but the bulk of the unused steam is returned to the reservoir to be used in the next cycle. Typical water flow rates of connectionless steamers are about 3 gph. Connectionless steamers can qualify for the ENERGY STAR label if they consume 3 gallons of water or less per hour and meet energy consumption goals as well, which are based on the fuel source. Electric food steamers must meet 50% cooking energy efficiency when cooking a heavy load of potatoes, and gas food steamers must meet 38% cooking energy efficiency under the same cooking conditions. Table 3 shows the savings between a standard boiler based food steamer and an ENERGY STAR connectionless food steamer.

Table 3. Commercial Food Steamer Savings

Machine	Standard boiler based	ENERGY STAR connection-less	Water savings	Annual water savings[a]	Annual energy savings
Steamer	40 gph	3 gph	92.5%	174.50 kgal	4,930 kWh or 33 MBtu

[a]6-pan steamer, heavy use

Commercial food steamer

Commercial ice machine

Ice Machines

There are two main types of ice machines—air cooled and water cooled. Water-cooled ice machines can be single-pass cooling systems that waste a significant amount of water, using 150 gallons per 100 pounds of ice made (gal/100 lb ice) just to cool the equipment. Air-cooled machines can be less energy efficient because water is better at removing heat than air; however, a study that analyzed the total life-cycle cost-effectiveness of ice machines clearly indicated that air-cooled machines are the most efficient and economical choice because of the tremendous water savings.[2]

Typical water use rates of air-cooled ice machines range between 20 and 30 gal/100 lb ice. To qualify for the ENERGY STAR label, an ice machine must be air-cooled and use less than 25 to 35 gal/100 lb ice, depending on model type. The Exchange's sustainability plan calls for installing ENERGY STAR qualified ice machines at its facilities. Table 4 shows the savings between a water-cooled ice maker and an ENERGY STAR qualified air-cooled ice maker.

Table 4. Commercial Ice Maker Savings

Machine	Water-cooled	ENERGY STAR air-cooled	Savings	Annual water savings	Annual energy savings
Ice maker	150 gal/ 100 lb ice	25–35 gal/ 100 lb ice	76%–83%	2.50 kgal	1,200 kWh

Additional Water Efficiency Opportunities

In addition to the technologies discussed in this case study, the Exchange is also implementing water-efficient technologies in and out of the commercial kitchen. In the commercial kitchen, the Exchange's sustainability plan calls for installing low-flow nozzles for sinks and pressure-controlled foot pedals for hand sinks. In ice cream shops, on-and-off valves for dipper wells are being installed so that the wells do not run continuously. Outside the commercial

[2] Food Service Technology Center (2007). A Field Study to Characterize Water and Energy Use of Commercial Ice-Cube Machines and Quantify Savings Potential. *www.fishnick.com/publications/appliancereports/special/Ice-cube_machine_field_study.pdf.* Accessed December 2010.

LEED Silver shopping center food court, Fort Bliss, Texas. *Photo from U.S. Army*

kitchen, the Exchange is installing more water-efficient fixtures in restrooms and, wherever possible, installing native landscaping or xeriscaping to avoid the need for a permanent irrigation system. With these new standards, a typical Exchange Food Court can reduce its water consumption by more than 220,000 gallons per year.

In one example of equipment replacement at Exchange facilities, steamers were replaced with equipment that doesn't use water. Prior to remodeling, food court lessee Taco Bell heated taco meat and tortillas in food steamers and steam tables so that they were available when an order was placed. After remodeling, the steam tables were replaced with dry wells and the food steamers were replaced with a small griddle. Now, when an order is placed, a tortilla is warmed on the griddle instead of being removed from the food steamer. The combined savings of 3,000 locations, including the restaurants in Exchange facilities, is approximately 300 million gallons of water annually and 200 million kilowatt-hour (kWh) of electricity. The simple payback period for the Exchange's new equipment is 6.5 years.

In Louisiana, Fort Polk opened the doors to its new Exchange in April 2010. This new facility incorporates all of the sustainable ideas from the Exchange's sustainability plan. By incorporating the technologies in this case study and others, such as non-flushing urinals and low gallon-per-flush technology in its restrooms, the Exchange will be seeking Silver certification from the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED™) rating system.

[3] Mr. Kidd became the Deputy Assistant Secretary of the Army (Energy & Sustainability) on October 25, 2010.

Acknowledgements

FEMP acknowledges the following individuals for supporting this program and case study:

- Eduardo Torres, Army and Air Force Exchange Service Senior Restaurant Program Planner
- Mel Hendricks, Army and Air Force Exchange Service Corporate Energy Program Manager

For More information

FEMP Water Efficiency program: *www.femp.energy.gov/program/waterefficiency.html*

FEMP Water Efficiency Best Management Practices: *www.femp.energy.gov/program/waterefficiency_bmp.html*

ENERGY STAR: *www.energystar.gov*

Additional information on the Exchange and all Exchange facilities: *www.shopmyexchange.com/pa/default.asp*

Food Service Technology Center: *www.fishnick.com*

FEMP awarded the Exchange with a Federal Energy and Water Management Award. Pictured from left to right are Richard Kidd, former Program Manager[3], FEMP; Dorothy Robyn, Deputy Under Secretary of Defense for Installations and Environment; Mel Hendricks, Exchange Corporate Energy Program Manager; Major General Bruce A. Casella, U.S. Army, Exchange Commander; and Dr. Kathleen Hogan, Deputy Assistant Secretary for Energy Efficiency, Office of Energy Efficiency and Renewable Energy. *Photo from U.S. Army*

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

For additional information please contact:
EERE Information Center
1-877-EERE-INFO (1-877-337-3463)
www.eere.energy.gov/informationcenter

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.

FEMP Federal Energy Management Program

DOE/GO-102011-3205 • September 2011