Office Equipment and Other Plug Loads: Vending Machine Energy Savings

Refrigerated vending machines operate 24 hours per day, seven days a week. In addition to consuming 2,500 to 4,400 kilowatt-hours (kWh) of energy per year, they add to cooling loads in the spaces they occupy. At average electricity costs of about US$0.08/kWh, annual operating costs can range from $200 to $350.

New, efficient vending machines are available that can greatly reduce operating costs. Additionally, the use of timers or occupancy sensors can lead to big savings, because they allow the machines to turn on only when a customer is present or when the compressor must run to maintain the product at the desired temperature.

What Are the Options?

Occupancy sensing. At least one device now on the market uses a passive infrared occupancy sensor (PIR) to turn off the compressor and fluorescent lights in the vending machine when no one is around. In addition, a temperature sensor powers up the machine at appropriate intervals to keep the products cool enough (see **Figure 1**).

In typical operation, power is cut to the vending machine after the area has been vacant for 15 minutes. The device is designed so that a machine in a room that's around 70 degrees Fahrenheit will be shut down for up to two hours if no one walks by. At that point, the machine is turned back on to run a compressor cycle, after which it turns back off if the occupancy sensor still indicates that no one is in the area. When someone approaches, the sensor sends a signal to turn the lights and other electronic components back on, and the compressor runs a cooling cycle if needed.

Figure 1: Vending machines controlled by occupancy sensors

This soda machine sits between two others, each of which has its own occupancy sensor and controller. Sensors need to be mounted away from ceiling air ducts to prevent false triggering.

Source: Bayview Technology Group

The control logic ensures that after the machine is repowered, the compressor is allowed to run a complete cooling cycle before it is powered down again. A sensor also determines whether the compressor is running and prevents the machine from shutting down until the cycle has been completed. Both of these features ensure that a high-head-pressure start, which would strain the compressor, never occurs. An indicator light goes on if the compressor has been running for more than two hours—a signal that maintenance may be required.

Savings for vending machines equipped with these devices range from 24 to 76 percent, depending on usage patterns, occupancy in the area, and ambient conditions. Occupancy sensors can be most cost-effective when the machine is located in such a way that people trigger the sensor only when they want to purchase something.

Location. Vending machines located in cool and shaded areas tend to last longer, use less energy, and demand less power. Ambient conditions, such as high temperatures or direct solar gain, can make the compressor work harder to maintain the appropriate environment for snacks and beverages.

Improved lighting. A typical modern vending machine with a lighted front display panel uses two or three 4- or 5-foot high-output T12 fluorescent lamps powered by conventional magnetic ballasts, drawing as much as 180 watts of power. This continuous load consumes 1,580 kWh per year (for an annual total of $126 at 8¢ per kWh). The heat from the lights also increases the machine's refrigeration load.

Instead, look for or request machines that use low-temperature electronic ballasts paired with T8 lamps, which could reduce lamp power to about 80 watts. In addition, high-color-rendering T8s can significantly improve the appearance of the translucent front panel.

In one test, disconnecting a vending machine’s lights cut energy use by 35 percent. However, users' attempts to get operators to disconnect the lights don't always meet with success. Adding a simple timing mechanism to turn the lights off in the late evening is another option.

Energy Star appliances. Vending machines that comply with Energy Star specifications use efficient compressors, fan motors, and lighting systems and are up to 50 percent more efficient than standard models. In order to receive the Energy Star label, a vending machine must meet the energy consumption criteria set forth by the most current version of the specification and must incorporate software that can operate the vending machine in a low-power light state, low-power refrigeration state, or a whole-machine low-power state. For details on current Energy Star specifications, visit www.energystar.gov/index.cfm?c=vending_machines.pr_vending_machines.

How to Make the Best Choice

Talk to your vendor. Whether you are in the middle of your contract or entering a new one, request Energy Star vending machines or the highest-efficiency models possible. These high-efficiency machines will reduce operating costs.

Focus on location. The parameter that has the greatest impact on energy savings is location: the higher the traffic, the lower the savings. For example, in one test, when occupancy sensors were added to a machine located in a busy hotel lobby, relatively low energy savings resulted—roughly 25 percent. Generally speaking, locations that are unoccupied during nights and on weekends present the best opportunities for savings, although some energy can be saved as long as the area is unoccupied for more than 15 minutes

at a time. Teachers' lounges, break rooms, office buildings, and school cafeterias are good potential sites for saving energy with occupant sensing.

The temperature of the space where the machine is located also affects energy consumption. Lower ambient temperatures typically increase energy savings.

Assess how often the compressor runs. Other factors that affect energy savings relate to how often the compressor needs to turn on to keep the products cool. If a room's temperature is warmer than normal, the compressor will have to turn on more frequently. Likewise, if one machine has a product that is popular, that machine will be stocked with room-temperature products more often, causing the compressor to work harder to cool the product.

Because vending machines, like refrigerators, emit heat during operation, reducing "on" time will also reduce total air-conditioning loads when the vending machine is located in an air-conditioned space. It is unlikely, however, that occupancy sensing will reduce peak air-conditioning loads, as those loads generally correspond with peak occupancy rates.

What's on the Horizon?

Vending machines typically cool less than half the volume of a home refrigerator, yet they may use more than five times as much energy. So the potential for improvements by manufacturers is huge. In addition to better lighting, potential efficiency improvements for beverage venders include more or better insulation, more-efficient or variable-speed compressors, improved condenser heat transfer, more-efficient fans and motors, and control changes to the refrigeration cycle (such as raising setpoints during late-night hours or other times of low use).

Researchers recently incorporated some of these improvements into a super-efficient vending machine that reduced daily energy consumption by 40 percent compared to a conventional machine. This prototype also reduced typical peak demand by over 50 percent. Through the combination of these improvements and a redesigned evaporator, condenser, and heat exchanger, the researchers also found that they were able to keep the products at low temperatures, even when ambient temperatures were as high as 120° Fahrenheit. Researchers hope that field demonstrations of this super-efficient prototype will spur the creation of federal efficiency standards for vending machines.