ENERGY STAR

GREEN THE CAPITOL WITH ENERGY-EFFICIENT VENDING MACHINES: A FIELD STUDY

CONTENTS

GREEN THE CAPITOL

With

ENERGY EFFICIENT VENDING MACHINES:

A Field Study

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for
U.S. EPA ENERGY STAR®

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EXECUTIVE SUMMARY

As part of the Green the Capitol Initiative, a field study gauging the energy and cost savings achieved by converting 53 refrigerated beverage vending machines to ENERGY STAR® models and operating them in low-power mode was conducted. The ENERGY STAR® Program Requirements for Refrigerated Beverage Vending Machines has been in effect since July 2007 and requires new and rebuilt machines to meet energy consumption levels and to be equipped to operate in a low power mode. While the energy savings of an ENERGY STAR qualified vending machine is documented, the additional savings of operating the machine in one or all of its low power modes is the subject of this field study. The low power modes the study looked at are low-lighting mode and raising refrigeration temperature.

The study found that 17 ENERGY STAR vending machines operated in *low-lighting mode* used 22 percent less electricity—177W rather than 226W—when machine lights were deactivated for 12 hours per day. On average, the 17 ENERGY STAR vending machines used 3 percent less energy when their *refrigeration temperature* was raised from 36 °F to 38 °F for 12 hours per day. At an annual energy savings of $59 per machine, activating low-power modes yields:

+ Payback in approximately 2 months.
+ An annual return on investment of approximately 600 percent.

The study yielded the following conclusions regarding ENERGY STAR qualified vending machines:

+ Of the two low-power modes available in ENERGY STAR qualified vending machines, lighting controls appear to save seven times more electricity than refrigeration temperature controls, for assumed software set points.
+ There is a strong business case for activating low-power modes on ENERGY STAR qualified vending machines. Both return on investment and payback metrics strongly favor their activation.

INTRODUCTION

On March 1, 2007, the Speaker and the Majority Leader of the U.S. House of Representatives directed the Chief Administrative Officer of the House to develop a "Green the Capitol Initiative" demonstrating leadership to the nation by providing an environmentally responsible and healthy working environment for employees. The House adopted three goals for future operations:

+ Operate the House in a carbon-neutral manner by the end of the 110th Congress, January 3, 2009.
+ Reduce the House's carbon footprint by cutting energy consumption by 50 percent in 10 years.
+ Make House operations a model of sustainability.

ASSESSMENT OF VENDING MACHINES IN THE CAPITOL

As part of the Green the Capitol Initiative, Lawrence Berkeley National Laboratory (LBNL)[1] evaluated the energy consumption of vending machines in areas of the House Side of the Capitol complex in January 2008:

+ Capitol Heights mail processing center
+ Capitol Power Plant
+ U.S. House of Representatives Page Dormitory
+ Ford House Office Building
+ Rayburn House Office Building
+ Longworth House Office Building
+ Cannon House Office Building
+ Capitol Building

LBNL focused on cold beverage vending machines. The cold beverage vending machines, in addition to being more numerous and generally more energy intensive than other types of vending machines, are covered under the current ENERGY STAR program.

LBNL's survey of 53 cold beverage vending machines and 29 coffee, snack, food or ice cream vending machines found that:

+ Many vending machines used T12 type lamps instead of more efficient T8 lamps found in new or newly retrofitted machines.
+ Only eight of the 53 cold beverage vending machines were ENERGY STAR qualified.

REPLACEMENT WITH ENERGY STAR VENDING MACHINES

All cold beverage vending machines were replaced with ENERGY STAR compliant machines during Spring 2008. Researchers at LBNL estimate that ENERGY STAR qualified machines are fifty percent more efficient than standard vending machines. ENERGY STAR qualified machines use more efficient compressors, fan motors and lighting to save over 1,500 kWh/year compared to non-qualified models.

Installing ENERGY STAR qualified machines and activating onboard low-power modes can save approximately $200 in annual electricity costs per unit, compared with standard models.[2]

[1] LBNL is a member of the national laboratory system supported by the U.S. Department of Energy through its Office of Science.

[2] Put Another Nickel In: Market Opportunities for ENERGY STAR Vending Machines, Overcoming the Barriers of Leased Equipment (Presented at IEPEC 2007, Shaw, Mapp, Lewis, et al.)

LOW-POWER FEATURES OF ENERGY STAR QUALIFIED VENDING MACHINES

ENERGY STAR qualified vending machines come equipped with hard-wired controls or software capable of placing the machines in a low-power mode during periods of extended inactivity to increase energy savings. ENERGY STAR qualified vending machines can operate in at least one of these low-power mode states:

+ Lighting low-power state: the lights are turned off for an extended period of time.
+ Refrigeration low-power state (storage mode): the average beverage temperature is allowed to rise to a user-defined temperature for an extended period of time.
+ Whole machine low-power state: the lights are turned off and the machine operates in refrigeration low-power state.

Shortly after installation, software controls were activated on all machines to turn off their lights at night.

LBNL RECOMMENDATIONS

Given the benefits of ENERGY STAR qualified vending machines, LBNL recommended the following:

+ All non-ENERGY STAR cold beverage vending machines be replaced with an ENERGY STAR model that uses less energy and the lighting low-power mode should be activated.
+ The refrigeration low-power mode, if available on the replacement unit, should be activated. In order to prevent power surges, it may be prudent to stagger the times when individual machines return from low-power refrigeration mode to normal cooling mode.

PROBLEM STATEMENT

Although there is a great deal of information about how much energy can be saved by using ENERGY STAR qualified vending machines, little data is available on the energy savings achieved in the field by these machines' additional low-power state capabilities. The low-power settings are not activated at most facilities due to a lack of awareness about them. In addition, vending machine distributors generally want the lights on all the time to drive sales and to keep products at the optimum temperature.

If all of the vending machines in federal offices were replaced with equivalent ENERGY STAR qualified models using software settings similar to those in this study, annual energy savings could total as high as 72 million kWh, with 17 million to 18 million kWh saved due to the software settings alone. The trade publication Vending Times estimates there are about 100,000 vending machines at 12,000 other government and military facilities. Activating the low-power settings of these vending machines could achieve annual savings of up to an additional 50 million to 55 million kWh. (from page 13 of the study).

With its aggressive savings goals and hope for becoming a model of sustainability, the Green the Capitol Initiative was interested not only in using ENERGY STAR qualified vending machines but also in activating their low-power-state capabilities. Initiative leaders agreed to a field study quantifying the savings achieved by activating these settings. The Cadmus Group, Inc., a U.S. Environmental Protection Agency (EPA) ENERGY STAR contractor, was brought in to work with LBNL and representatives of the Green the Capitol Initiative to answer the question:

Are the savings achieved by activating energy-saving features available on ENERGY STAR vending machines—automated low-power lighting and temperature adjustments—greater than the costs of activating the features?

TABLE 1: STUDY TASKS AND RESPONSIBILITIES

TASK/RESPONSIBILITY	RESPONSIBLE PARTY
Monitor and verify energy use and savings	Cadmus/Canteen
Adjust of vending machine low-power features	Canteen
Process description and history of vending machine replacement process	LBNL/Canteen
On-site logistics and coordination	LBNL/Cadmus
Case study development	Cadmus

TABLE 2: ENERGY STAR QUALIFIED VENDING MACHINES METERED

BUILDING/ LOCATION	PRODUCT	MAKE	MODEL NUMBER	SERIAL NUMBER
Capitol/ Vending Hall (Basement)	Pepsi	Dixie Narco	DN720PHVV-12	78480031
Capitol/ Vending Room	Pepsi	Dixie Narco	DN720P HVV-12	78480044BG
Ford/ Vending Room	Dasani	Royal	8000	200736BA00058
Ford/ Vending Room	Pepsi	Dixie Narco	DN720P-HVV-12	78480028
Ford/ Vending Room	Coke Zero	Royal	RVCC660-8	200808BA00005
Ford/ Vending Room	Coca Cola	Royal	RVCC-660-8	200808BA00009
Ford/Vending Room	Pepsi	Dixie Narco	DN720P HVV-12	78480050
Longworth/ Vending	Pepsi	Dixie Narco	DN720P HVV-12	78480039
Longworth/ Vending	Pepsi	Dixie Narco	DN720PHVV-12	78480025
Longworth/ Vending	Red Bull	Royal	RVRB-372-3	200612NA00080
Rayburn/ Cafeteria	Pepsi	Dixie Narco	DN720P HVV-12	78480057
Rayburn/ Cafeteria	Coca Cola	Royal	RVCC-660-8	200808BA00012
Rayburn/ Cafeteria	Coca Cola	Royal	RVCC-660-8	200808BA00016
Rayburn/ Cafeteria	Coke Zero	Royal	RVCC-660-8	200808BA0007
Rayburn/ Cafeteria	Red Bull	Royal	RVRB 372-3	200604NA00315
Rayburn/ Gym	Pepsi	Dixie Narco	DN720P-HVV-12	78480054
Rayburn/ Subway	Pepsi	Dixie Narco	DN7208-HVV-12	78480040BG
Rayburn/ Subway	Pepsi	Dixie Narco	DN720HVV-12	78480045
Rayburn/ Subway	Dasani	Royal	RVCC-660-8	200736BA00036
Rayburn/ Subway	Coca Cola	Royal	RVCC-660-8	200808BA00027
Rayburn/ Subway	Coca Cola	Royal	RVCC-660-8	200808BA00010
Rayburn/ Subway	Pepsi	Dixie Narco	DN720PHVV-12	78480033
Rayburn/ Vending Room/Cafeteria	Pepsi	Dixie Narco	DN720P HVV-12	78480036
Rayburn/ Woodshop	Pepsi	Dixie Narco	DN276E HV/511-6	76200308
Rayburn/ Woodshop	Coca Cola	Royal	RVCC-660-9	200808BA00017

Representatives from Canteen, Cadmus and Lawrence Berkeley National Laboratory traveling between House office buildings to install monitoring equipment for the study.

TABLE 3: GREEN THE CAPITOL VENDING STUDY SCHEDULE

MILESTONE	DATE(S)
Installation of monitoring equipment and begin monitoring "as is"	7/24/2008
Monitor "as is" energy consumption	7/24 – 8/12/2008
De-activate all low-power features	8/13/2008
Monitor "no low-power features enabled" energy consumption	8/13 – 8/21/2008
Activate low-power lighting feature	8/22/2008
Monitor "only low-power lighting feature enabled" energy consumption	8/22 – 9/17/2008
Activate low-power refrigeration mode	9/18/2008
Monitor "all low-power features enabled" energy consumption	9/18 – 10/17/2008

SCOPE OF THE STUDY

ROLES AND RESPONSIBILITIES

This study was led by The Cadmus Group, Inc. The U.S. EPA ENERGY STAR, the Green the Capitol Office, Canteen and LBNL provided feedback and support. The division of responsibilities is presented in Table 1.

MACHINES TO BE MONITORED

Twenty-five cold beverage vending machines in the Capitol Building and the Ford, Rayburn and Longworth office buildings were metered. The machines were selected from a list compiled by LBNL after completing a field audit and comparing the installed machines to the current Qualified Product List for ENERGY STAR vending machines. The machines selected for monitoring are listed, by location, in Table 2.

SCENARIOS EXAMINED

Four energy-use scenarios were analyzed on 25 ENERGY STAR qualified vending machines through onsite metering. The progression of scenarios is presented below.

+ **As Is:** As originally installed, with enablement of low-power features noted.
+ **No Low-power Features Enabled:** Lighting and refrigeration low-power mode features de-activated.
+ **Only Low-power Lighting Feature Enabled:** Lighting low-power mode activated via hard-wired controls and software.
+ **All Low-power Features Enabled:** Lighting and refrigeration low-power modes activated via hard-wired controls and software.

PRELIMINARY SCHEDULE

Table 3 shows the progression of significant milestones during the study.

IMPLEMENTATION STEPS

STEP 1: INSTALL MONITORING EQUIPMENT AND RECORD SETTINGS

On July 24, 2008, Cadmus and Canteen representatives began long-term metering of cabinet light level and average AC power draw at each vending machine by installing the following equipment:

+ Hobo Onset Pendant Logger UA -002, which records average light level readings (lumens/sq. ft.) every 3 minutes. A logger was hung inside each vending machine next to the lighting source to verify that software settings had been successfully implemented. (See Figure 2.)
+ Watts Up Pro ES, which measures energy consumption and power, recorded average values every minute to track the machines' real-time energy use. These meters were installed between the electrical outlets and each vending machine. (See Figure 2.)

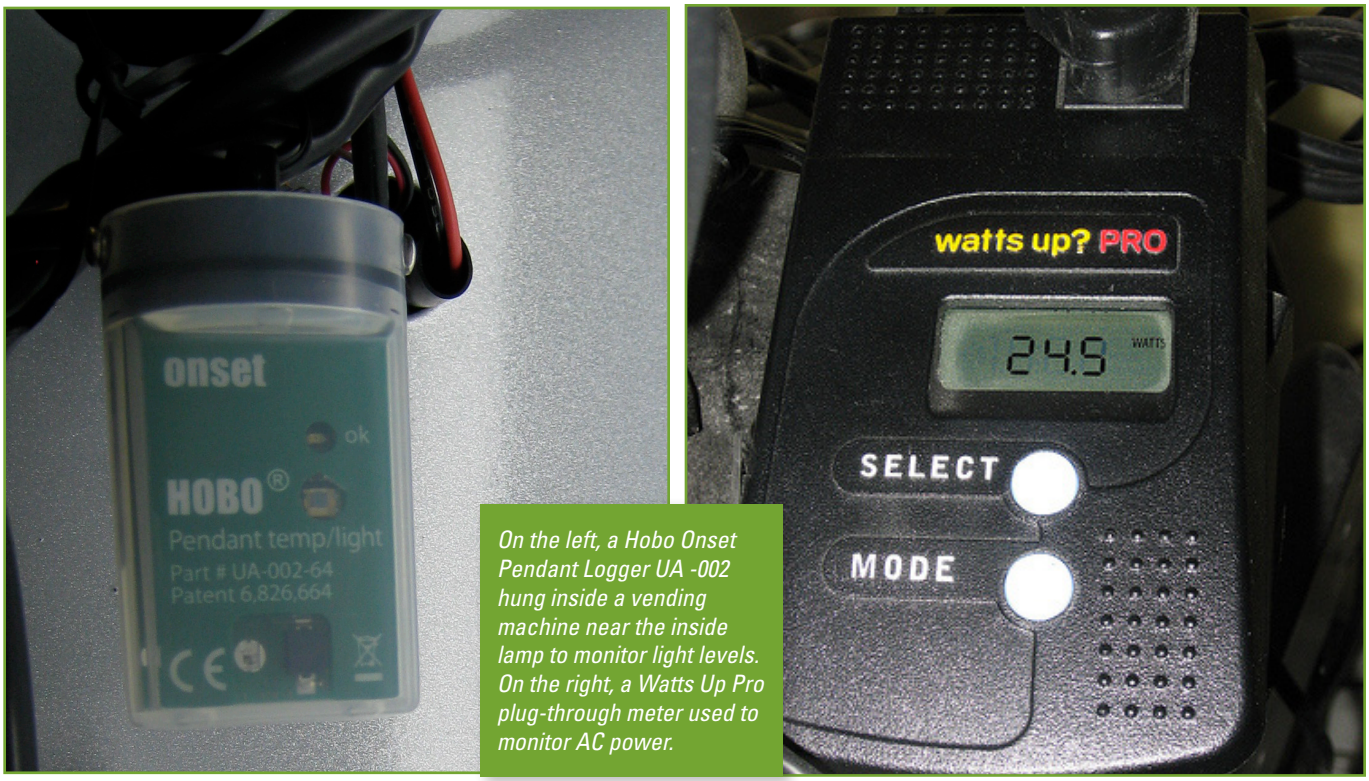
The meters were installed in this manner:

+ Each vending machine was pulled away from the wall allowing access to the power cord. The Watts Up Pro was installed between the vending machine and the nearest available wall outlet to measure the energy consumed by the entire machine, but none of the energy consumed by other machines. (For example, if several machines were plugged into a single outlet via a power strip, care was taken to measure only one machine's electricity use per power meter).
+ The refrigerated cabinet of each machine was opened and a pendant logger installed inside. The logger was placed so it would not interfere with the machine's operation as it measured average light levels to determine whether software controls were properly configured and working.

The following information was recorded at the time the meters were installed:

+ Time and location.
+ Nameplate information (model, number, serial number, brand).
+ Presence of ENERGY STAR label.
+ Type of product sold.
+ Meter identification numbers.
+ Low-power state settings.

FIGURE 2



On the left, a Hobo Onset Pendant Logger UA -002 hung inside a vending machine near the inside lamp to monitor light levels. On the right, a Watts Up Pro plug-through meter used to monitor AC power.

STEP 2: CHANGING SETTINGS TO ADJUST LOW-POWER STATES

Canteen representatives adjusted the low-power state settings of each machine three times during the study (see Table 1, Green the Capitol Vending Study Schedule). The first adjustment, for the No Low-power Features Enabled scenario, involved shutting off any low-power settings and leaving the machine in its original factory configuration. The second adjustment made, for the Only Low-power Lighting Feature Enabled scenario, involved adjusting lighting to turn off between the hours of 8 p.m. and 8 a.m. The third adjustment, for the All Low-power Features Enabled scenario, involved raising the refrigeration temperature to 38 °F during the hours between 8 p.m. to 8 a.m.

This procedure involved opening the vending machine door, activating the service mode, then adjusting both low-power state settings by pressing a sequence of commands on the vending machine keypad. Appendix 1 presents an example of the step-by-step procedure on a Dixie Narco vending machine.

STEP 3: RETRIEVE MONITORING EQUIPMENT AND ANALYZE DATA

On October 18, 2008, Cadmus and Canteen representatives retrieved the Hobo Onset Pendant Logger UA -002 and Watts Up Pro ES meters. The data were downloaded and analyzed.

DATA QUALITY CONTROL

As shown in the summary table in Appendix 2, eight of 25 monitored ENERGY STAR vending machines were excluded from the study.

- The two Dasani bottled water vending machines were removed because they use a different energy savings controller, the Elstat EMS 55-R, to manage their savings. It is unclear whether these controllers had any effect on machine energy use during the study period.
- The two Red Bull machines were removed because their low-power states could not be adjusted.
- Four machines—one Coke Zero vending machine (Watts Up 1206), one Pepsi machine (Watts Up Pro 1211) and two Coca-Cola machines (Watts Up 1219 and 1220)—were removed because a review of the data from these units disclosed week-long periods with inconsistent wattage readings which required further investigation. Cadmus believed that the data anomalies were due to internal errors in the metering equipment.

RESULTS AND DISCUSSION

LIGHTING AND REFRIGERATION SET POINTS IN EFFECT AT BEGINNING OF STUDY PERIOD

The refrigeration temperature in 21 of 25 vending machines was set between 35 °F and 37 °F and the lights were set to shut off from 8 p.m. to 8 a.m. (See the summary table in Appendix 2 for details.)

The two Red Bull vending machines did not have the ability to set low-power settings. Two vending machines that sold Dasani bottled water used the Elstat EMS 55-R. (See Figure 3,.) This special piece of hardware determines how a vending machine is used, then adjusts the machine's operation to make it more efficient. For example, if a vending machine goes unused on a weekend, the Elstat EMS 55-R turns down the refrigeration system. Coke claims vending machines equipped with the Elstat hardware will use 35 percent less energy than an equivalent machine without the device. Due to the timing of the study and the nature of the device, it was not possible to verify this claim from the data collected, and the equipped machines' energy use was not comparable to that of the machines adjusted through manual software changes. Information on the EMS 55-R is limited, but the device appears to track vending purchases and uses this information to optimize lighting and refrigeration settings. Based on the data collected, the device appears to use occupancy data from the previous week(s) to optimize current settings. The energy use of machines equipped with the EMS appeared to be comparable to machines that use manually programmed settings. The variability of the EMS device allows the machine to consume less energy during extended low-activity periods, but the machine's

energy use during other times will be comparable to that of an equivalent machine using onboard software controls. As these devices become more common, additional data should be collected to determine their effectiveness.

SAVINGS FROM LOW-POWER LIGHTING MODE

Savings between two scenarios were examined by comparing the average wattages in the following time periods, as shown in the summary table in Appendix 2:

+ From 12 a.m. on August 14 to 11:59 p.m. on August 21, representing a week-long period in the No Low-power Features Enabled scenario.
+ From 12 a.m. on August 24 to 11:59 p.m. on September 7, representing a two-week period in the Only Low-power Lighting Feature Enabled scenario.

These three weeks were selected because Congress was still on its summer break and occupancy patterns were consistent during that time.

On average, the 17 ENERGY STAR vending machines used 22 percent less energy when their lights were turned off for 12 hours a night. An ENERGY STAR qualified vending machine drew on average 226 watts when no low-power states were activated and only 177 watts when the lighting low-power state was activated. An example of this energy use by one vending machine is shown in Appendix 3.

SAVINGS FROM LOW-POWER REFRIGERATION TEMPERATURE MODE

As shown in the summary table in Appendix 2, savings were examined between the following two scenarios by comparing the average wattages in the following time periods:

+ From 12 a.m. on September 8 to 11:59 p.m. on September 15, representing a week-long period in the **Only Low-power Lighting Feature Enabled** scenario. Because the lighting is turned off only at night, the daytime data can be used as a baseline for comparison.
+ From 12 a.m. on September 9 to 11:59 p.m. on October 11, representing a three-week period in the **All Low-power Features Enabled** scenario.

Because the study period spanned times during which Congress was in session and in recess, and because the No Low-power Mode data was collected during recess, we could not compare these data with those from the combined Low -power lighting and Low-power Refrigeration Mode period. Changes in occupancy and use patterns had to remain consistent to support that comparison. Therefore, the daytime period of the Only Low-power Lighting Feature Enabled Scenario was used instead to represent No Low-power feature period, to ensure consistent occupancy patterns. The savings attributed to Low-power refrigeration mode were determined by comparing data from when the Low-power lighting mode was enabled with data from when the Low-Power lighting and Low-power refrigeration modes were both enabled. Both these periods occurred while Congress was in session, so there were consistent occupancy patterns.

The 17 ENERGY STAR vending machines used on average 3 percent less energy when their refrigeration temperature was raised to 38 °F for 12 hours a night. An ENERGY STAR qualified vending machine drew 186 watts on average when only the lighting low-power state was activated, but only 179 watts on average when both the lighting and refrigeration low-power states were activated, a savings of approximately 3 percent. Assuming the average indoor temperature is 70 °F, each degree above 36 °F that the cabinet temperature increases for 24 hours should reduce energy use by 3 percent. Most of the machines in the study were set between 38 °F and 36 °F for a 12-hour period, resulting in an expected savings of around 3 percent, similar to the measured savings observed.

COST EFFECTIVENESS AND FEASIBILITY

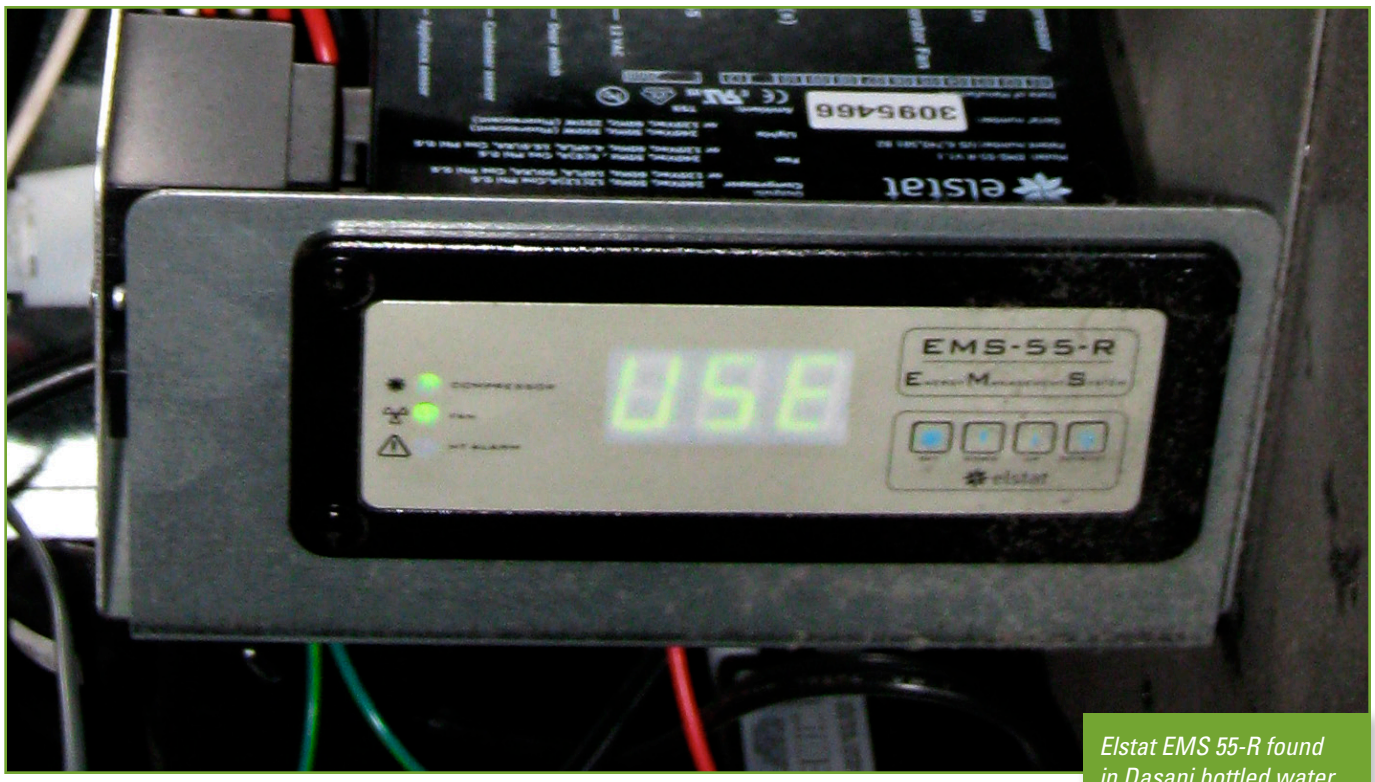
As shown in the summary table in Appendix 2, average overall savings were estimated to be 25 percent when both low-power modes are activated. This reduction in power consumption represents an annual savings of $59 per vending machine (at 12 cents per kWh, the average price of electricity in Washington D.C.).

We estimate that the only cost of activation is the labor cost for a vending machine technician to set the low-power states (approximately 10 minutes). We assumed no cost for travel to the site because the low-power states could be adjusted during vending machine maintenance or restocking. At $60/hour, the cost is roughly $10 per machine. At an annual energy savings of $59 per machine, activating low-power sleep modes yields:

+ Payback in approximately 2 months.
+ An annual return on investment of approximately 600 percent.

Based on Cadmus' experience working with vending operators and host sites, we believe many locations may be suitable for activating the settings evaluated in this study. Facilities that have defined operating hours such as factories or schools are a natural choice, and

FIGURE 3



Elstat EMS 55-R found in Dasani bottled water vending machines.

significant savings can be possible, particularly for sites with multiple vending machines.

Due to some bottling companies' constraints on product temperature and vending machine operators' related fears of customer dissatisfaction, many operators are reluctant to increase the internal machine temperature, even during periods when buildings are unoccupied. But as this study shows, most energy savings come when vending machine lights are turned off when the building is unoccupied. That observation suggests the bulk of the savings seen in this study can be achieved without affecting product temperature, customer satisfaction or sales volume. Both the low-power lighting and low-power refrigeration modes should be used where feasible, but, if that is not possible, considerable savings can be achieved by adjusting only the lighting mode set points.

The simplest way for host sites to have low-power settings activated is to ask their vending machine operator to do it. However, some operators will not be familiar with these settings or their activation. If an operator is unwilling or unable to make the desired changes, requests for bids on future vending contracts can specify particular set points.

If use of these settings becomes widespread, more training and education will need to be made available, especially to smaller vending operations. Such training can come from organizations such as the National Automated Merchandisers Association (NAMA) and be offered at regional distributor events.

POTENTIAL SAVINGS ACROSS THE FEDERAL GOVERNMENT OFFICE SPACE

The federal government owns an estimated 30,000 office buildings totaling 644 million square feet—4 percent of all office buildings and around 5 percent of all office floor space in the U.S.[3] Based on industry census data, Cadmus estimates there are approximately 36,000 vending machines in federally owned office space nationwide. (EPA estimates 3 million vending machines are in use in the United States.[4]) If all of the vending machines in federal offices were replaced with equivalent ENERGY STAR qualified models using software settings similar to those in this study, annual energy savings could total as high as 72 million kWh, with 17 million to 18 million kWh saved due to the software settings alone.

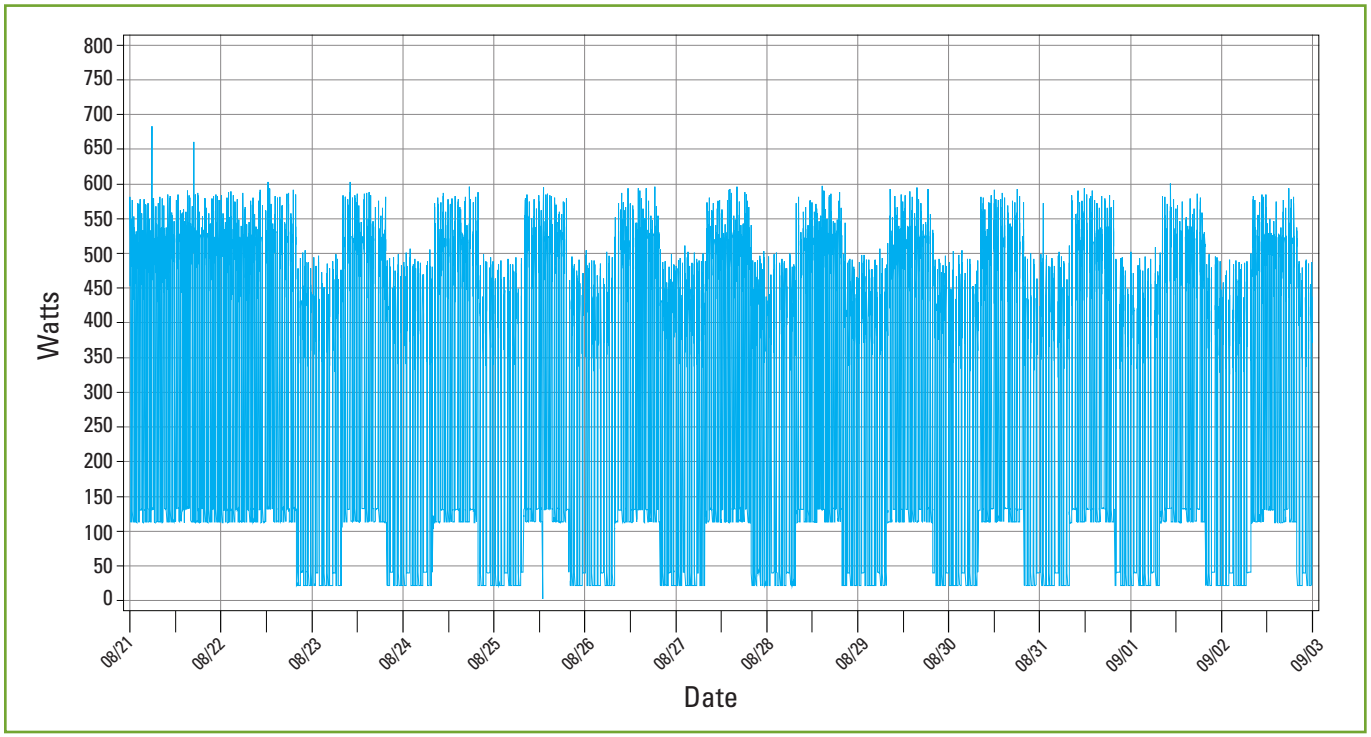
The trade publication Vending Times[5] estimates there are about 100,000 vending machines at 12,000 other government and military facilities. Activating the low-power settings of these vending machines could achieve annual savings of up to an additional 50 million to 55 million kWh.

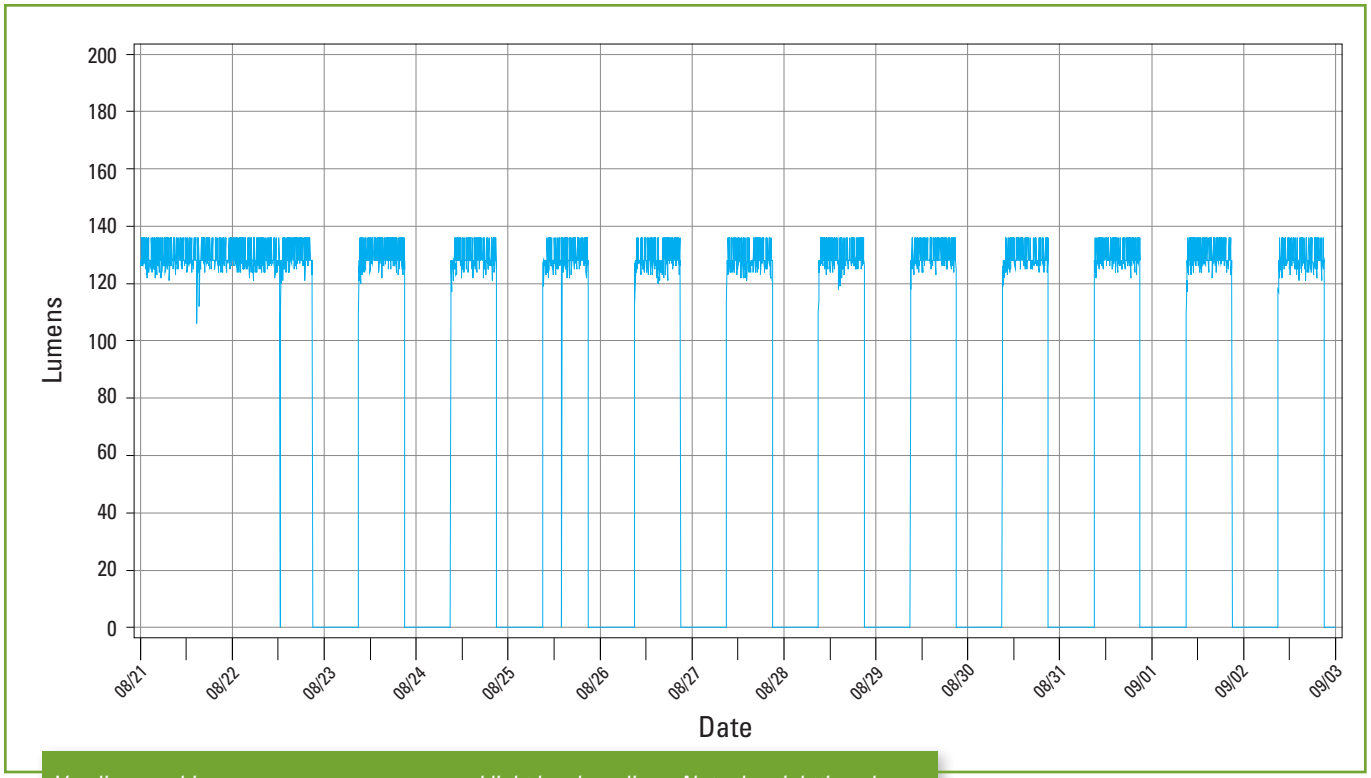
[3] Office of the Federal Environmen Executive the Federal Commitment to Green Building Experiences and Expectations (2003)

[4] ICF Industry and Marlot Research and Analysis, 2008

[5] 2008 Vending Times Census of the Industry

FIGURE 4





Vending machine energy average power and light level readings. Note the nighttime drops in energy use and light level beginning on 8/23 as lighting controls begin operating.

CONCLUSIONS

Based on this study, the following conclusions can be made regarding ENERGY STAR qualified vending machines:

- Of the two low-power modes available in ENERGY STAR qualified vending machines, the lighting controls appear to save seven times as much as much electricity as the refrigeration temperature controls, for an assumed typical set of software set points.
- There is a strong business case for activating low-power modes on ENERGY STAR qualified vending machines. Both return on investment and payback metrics strongly favor their activation.
- Many federal government facilities are ideal candidates for activating low-power states because federal agencies are required to use ENERGY STAR vending machines and generally have well-defined operating schedules.
- Lighting mode set points are likely to be more widely adopted than changes in the machine's internal temperature. Vending machine operators often are sensitive to product temperature because of the requirements of bottling companies and from fears of lost sales revenue if products are too warm.

RECOMMENDATIONS

Based on the results of this study, we recommend that ENERGY STAR consider the following:

- Work to make activation of low-power modes standard policy throughout the federal government, similar to the Executive Order 13423 requiring the activation of sleep settings on government computers.
- Develop and distribute outreach materials geared towards the federal government promoting the use of low-power modes in vending machines.
- Provide examples of procurement language for federal purchasing policies that require not only ENERGY STAR qualified vending machines but also activation of the low-power settings.
- Modify the ENERGY STAR program requirements so that manufacturers must place the ENERGY STAR logo in a more prominent location on the vending machine and must ship the qualified machines with power saving features turned on as the default.
- Develop a custom ENERGY STAR sticker for vending machines that helps soft drink vendors promote their green efforts as they activate software settings.
- Assist vending trade organizations and machine distributors in promoting use of the energy-saving software features and in implementing training programs for vending machine operators.
- Offer training and education on setting low-power mode features through organizations such as the National Automated Merchandisers Association (NAMA) to be offered at regional distributor events.

APPENDIX 1:
SAMPLE INSTRUCTIONS FOR SETTING LOW-POWER STATES

This is an example from a Dixie Narco vending machine and is included for illustrative purposes to outline the steps required to set a machine in low-power states. Inclusion of these instructions in no means implies an endorsement of Dixie Narco over any other suppliers. Please refer to specific manufacturer's instructions for other vending machines.

ENVIRONMENTAL CONTROLS

This control allows the user to view the energy conservation menu "Lighting," Refrigeration" and the "Relay" test menu. **When this control is programmed to "OFF" you will not see "Lighting," Refrigeration or Relay Test.** Press select button 1 and the current setting will be displayed (On or Off). Press and hold select button 1 to toggle between on and off. **(This feature is "OFF" from the factory.)** To move to Light, press and hold select buttons 1 and 2 simultaneously with this feature on. To move to Free Vend, press and hold select buttons 1 and 2 simultaneously with this feature off.

LIGHT

This function is used to turn the lights off during certain periods of the day. To enter the sub-menu, press select button 1. The following are sub-menus of the Light Menu: "Days," "Start," "Stop," "Enable" and "Return." To move to Refrigeration, press and hold select buttons 1 and 2 simultaneously.

Pressing select button 1 will enter "Days."

Days

Days of the Week:

Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
All Days
No Days
Return

This function is used to set the days of the week to turn lights off.

Press select button 1 and "Monday #" will show on the display, where # is "0" (disable) or "1" (enable). Press and hold select button 1 to toggle between "0" and "1".

Release the select button with the display showing the setting you wish to use. Press select buttons 1 and 2 simultaneously to scroll through all available days, "All Days," "No Days" and "Return." Press select button 1 at the "Return" prompt returns to "Days."

Press and hold select buttons 1 and 2 simultaneously to move to the next item on the menu.

Start

This function is used to set the hours and minutes when the lighting routine will start.

Press select button 1 and the current four-digit hour and minute setting will be displayed (24 hour).

Press and hold select button 1: Set Hours.

Press and hold select button 2: Set Minutes.

Press select buttons 1 and 2 simultaneously to move to the next item on the menu.

Stop

This function is used to set the hours and minutes when the lighting routine will stop.

Press select button 1 and the current four-digit hour and minute setting will be displayed (24 hour).

Press and hold select button 1: Set Hours.

Press and hold select button 2: Set Minutes.

Press select buttons 1 and 2 simultaneously to move to the next item on the menu.

Enable

This function is used to allow the lighting routine to go in to affect.

Press select button 1 and the current setting will be displayed (On or Off).

Press and hold select button 1 to toggle between "On" and "Off."

Release the select button showing the setting you wish to use and the display will return to "Enable."

Press select buttons 1 and 2 to scroll to "Return."

Return

Press select button 1 to return to "Light."

Press and hold select buttons 1 and 2 simultaneously to move to the next item on the menu.

REFRIGERATION

This function is used to electronically control the refrigeration operations of the vending machine. To enter the submenu, press select button 1. The following are sub-menus of the Refrigeration Menu: "Temperature," "Celsius or Fahrenheit," "Display," "Days," "Start," "Stop," "Storage Temperature," "Storage Enabled" and "Return." To move to Free Vend, press and hold select buttons 1 and 2 simultaneously. Press select button 1 to enter "Temperature."

Temperature

(Default Temperature 35 °F/15 °C)

This function is used to set the average product temperature for initial pull down and reload recovery.

Press select button 1 and "tt.tx" will show on the display where x is Fahrenheit or Celsius and tt.t is the degrees.

Press and hold select button 1 to increase or decrease the number by 1 °F or 0.5 °C. Release select button with the display showing the temperature you wish to use and display will return to "Temperature."

Press select buttons 1 and 2 to scroll to "Celsius or Fahrenheit."

Celsius or Fahrenheit

This function is used to set the degree reading to Fahrenheit or Celsius.

Press select button 1 and the current setting will show on the display. Press and hold select button 1 to toggle between Fahrenheit and Celsius. Release the select button with the display showing the setting you wish to use and the display will return to "Celsius or Fahrenheit." Press select buttons 1 and 2 to scroll to "Display."

Display

This function is used to enable the Temperature to be displayed following the "Ice Cold Drink" message. **"Sales Message" must also be set to ON for the temperature to be displayed.** Press select button 1 and "Display" will show on the display. Press select button 1 and the current setting will be displayed (On or Off). Press and hold select button 1 to toggle between "On" and "Off."

Press and hold select buttons 1 and 2 simultaneously to move to the next item on the menu.

Days

This function is used to set the days of the week to use Temperature Setting Routine.

Press select button 1 and "Monday #" will show on the display, where # is "0" (disable) or "1" (enable). Press and hold select button 1 to toggle between "0" and "1." Release the select button with the display showing the setting you wish to use. Press select buttons 1 and 2 simultaneously to scroll through all available days, "All Days," "No Days" and "Return." Press select button 1 at the "Return" prompt returns to "Days."

Press and hold select buttons 1 and 2 simultaneously to move to the next item on the menu.

Start

This function is used to set the hours and minutes for **Days of the Week:**

Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
All Days
No Days
Return

storage temperature to become active. Press select button 1 and the current four-digit hour and minute setting will be displayed (24 hour).

Press and hold select button 1: Set Hours.

Press and hold select button 2: Set Minutes.

Press select buttons 1 and 2 simultaneously to move to the next item on the menu.

Stop

This function is used to set the hours and minutes for storage temperature to become inactive. Press select button 1 and the current four-digit hour and minute setting will be displayed (24 hour).

Press and hold select button 1: Set Hours.

Press and hold select button 2: Set Minutes.

Press select buttons 1 and 2 simultaneously to move to the next item on the menu.

Storage Temperature

(Default Temperature 60 °F/16 °C)

This function is used to set the temperature for product storage. Press select button 1 and "tt.tx" will show on the display; x is Fahrenheit or Celsius and tt.t is the degrees. Press and hold select button 1 to increase or decrease the degrees by 1 or 0.5. Release the select button with the display showing the temperature you wish to use and the display will return

to “Storage Temperature.” Press select buttons 1 and 2 simultaneously to scroll to “Storage Enabled.”

Storage Enabled

This function is used to enable the storage setting to go into effect.

Press select button 1 and the current setting will be displayed (On or Off).

Press and hold select button to toggle between “On” or “Off.”

Release the select button showing the setting you wish to use and the display will return to “Storage Enabled.”

Press select buttons 1 and 2 to scroll to “Return.”

Return

Press select button 1 at “Return” to return to “Refrigeration.”

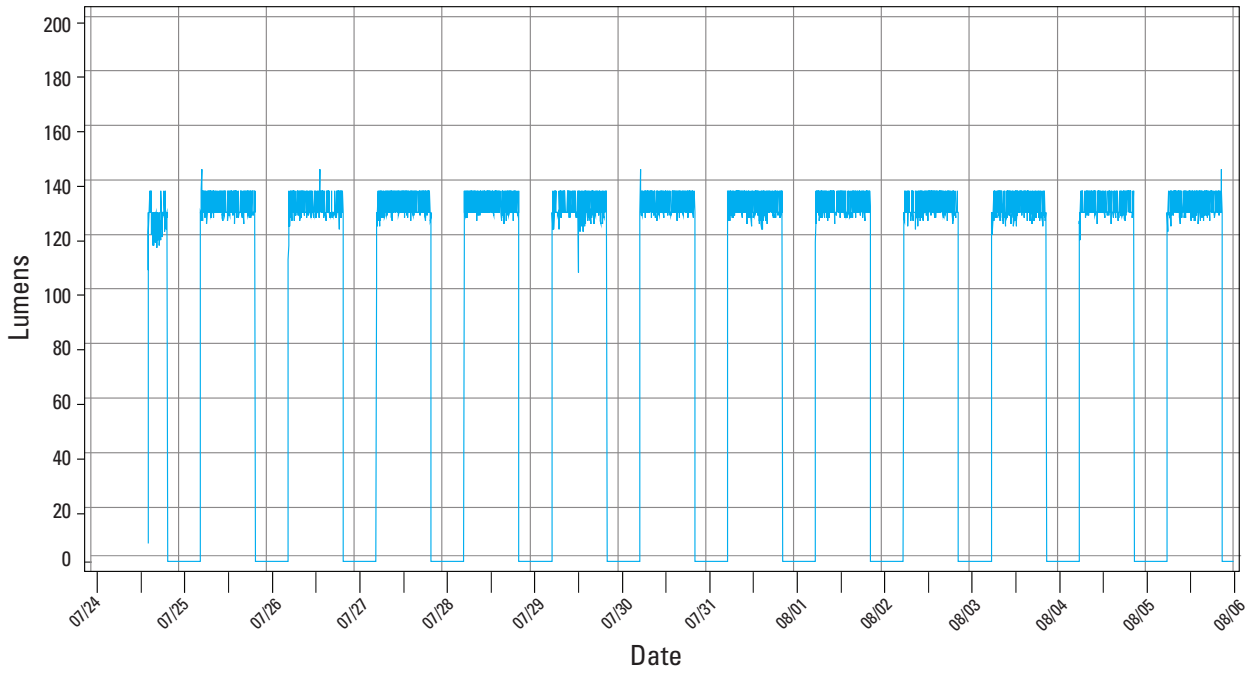
Press select buttons 1 and 2 simultaneously to scroll to next item on the menu.

APPENDIX 2: SUMMARY TABLE OF SAVINGS DATA FROM DIFFERENT VENDING MACHINES

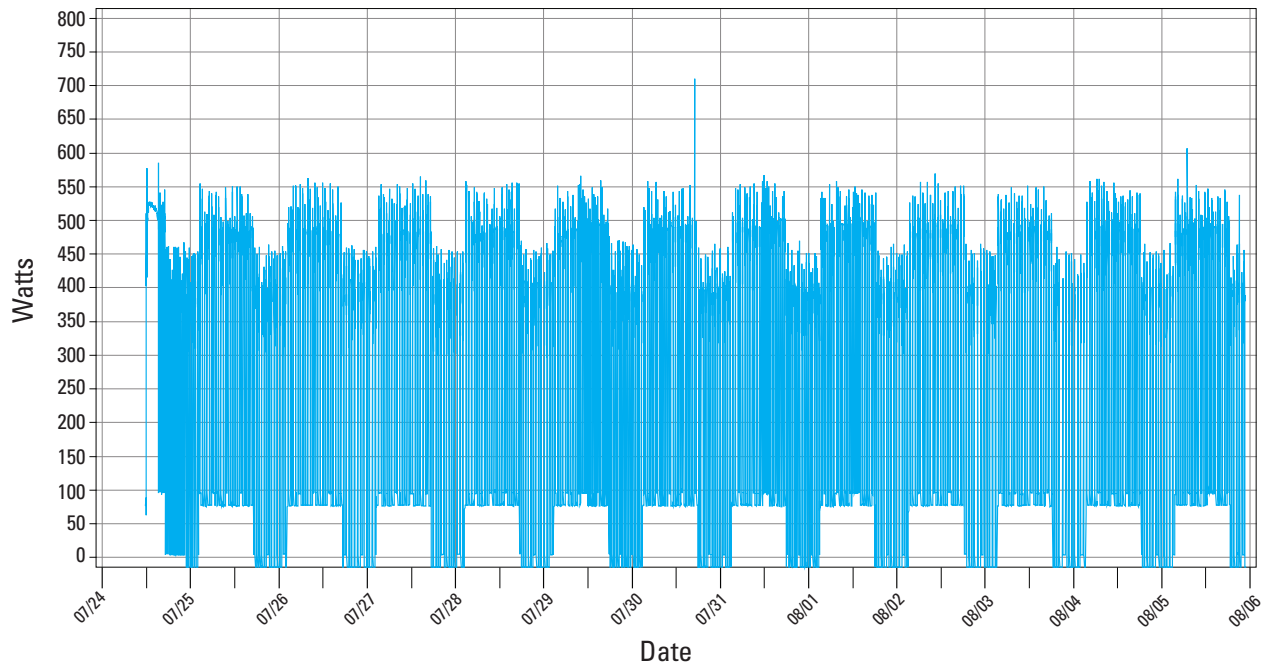
GENERAL	VENDING MACHINE INFORMATION				REMOVAL		AVERAGE POWER (W)				PERCENT SAVINGS		TOTAL SAVINGS	
Building/Location	Product	Make	ES Label?	Model	Removed from Analysis?	Why? (BD = Bad Data, CA = Can't Adjust; EMS = Used Energy Management System system)	No Low-Power Features Enable (8/14/08 to 8/21/08 During Summer Break)	Low-Power Lighting Feature Enabled Only (8/24/08 to 9/7/08 During Summer Break)	Low-Power Lighting Feature Enabled Only (9/8/08 to 9/15/08 After Summer Break)	All Low-Power Features Enabled (9/20/08 to 10/11/08 After Summer Break)	% Savings from Low-Power Lighting Feature Enabled During Summer Break	% Saving from Activating Refrigeration Temperature Low Power State After Summer Break	Total Reduction-Avg. Power (W)	Annual $ Savings at 9 cents/kWh
Rayburn/Cafeteria	Red Bull	Royal	N	RVRB 372-3	Y	CA	205.9	197.7	205.1	204.7	4%	0%	8.67	$9.11
Ford/Vending Room	Coke Zero	Royal	Y	RVCC660-8	Y	BD	231.1	125.4	202.3	207.7	46%	-3%	99.46	$104.55
Longworth/Vending	Red Bull	Royal	Y	RVRB-372-3	Y	CA	232.0	237.0	240.0	215.6	-2%	10%	18.70	$19.66
Rayburn/Subway	Dasani	Royal	Y	RVCC-660-8	Y	EMS	216.7	185.0	174.1	168.1	15%	3%	39.10	$41.10
Rayburn/Subway	Pepsi	DN	Y	DN720PHVV-12	Y	BD	339.4	412.4	385.7	175.3	-22%	55%	112.10	$117.84
Ford/Vending Room	Dasani	Royal	Y	8000	Y	EMS	196.1	147.0	151.7	167.3	25%	-10%	28.97	$30.45
Rayburn/Woodshop	Coca Cola	Royal	Y	RVCC-660-9	Y	BD	660.6	660.6	660.6	660.6	0%	0%	-	$-
Rayburn/Subway	Coca Cola	Royal	Y	RVCC-660-8	Y	BD	220.0	229.9	210.2	195.8	-4%	7%	5.17	$5.43
Ford/Vending Room	Pepsi	DN	Y	DN720P-HVV-12	N		220.9	166.0	169.8	174.2	25%	-3%	49.24	$51.76
Rayburn/Gym	Pepsi	DN	Y	DN720P-HVV-12	N		215.5	166.9	174.8	160.3	23%	8%	66.49	$69.89
Rayburn/Woodshop	Pepsi	DN	Y	DN276E HV/511-6	N		221.9	169.8	174.6	157.3	24%	10%	74.16	$77.96
Rayburn/Vending Room/Cafeteria	Pepsi	DN	Y	DN720P HVV-12	N		270.9	210.5	235.6	225.5	22%	4%	72.07	$75.76
Capitol/Vending Room (Capitol Vending HB10)	Pepsi	DN	Y	DN720P HVV-12	N		207.4	160.7	170.3	168.8	23%	1%	48.48	$50.97
Rayburn/Subway	Pepsi	DN	Y	DN7208-HVV-12	N		213.9	161.3	163.0	154.8	25%	5%	63.38	$66.62
Capitol/Vending Hall (Basement)	Pepsi	DN	Y	DN720PHVV-12	N		233.6	189.0	194.5	188.8	19%	3%	51.42	$54.05
Rayburn/Cafeteria	Coca Cola	Royal	Y	RVCC-660-8	N		199.9	162.9	162.3	172.6	19%	-6%	24.32	$25.56
Longworth/Vending	Pepsi	DN	Y	DN720P HVV-12	N		234.0	184.1	202.0	187.2	21%	7%	67.06	$70.49
Rayburn/Subway	Coca Cola	Royal	Y	RVCC-660-8	N		229.8	183.6	190.0	162.4	20%	14%	79.46	$83.53
Rayburn/Subway	Pepsi	DN	Y	DN720HVV-12	N		237.3	180.9	185.8	170.7	24%	8%	75.62	$79.49
Rayburn/Cafeteria	Coca Cola	Royal	Y	RVCC-660-8	N		239.8	187.9	204.5	183.0	22%	11%	77.08	$81.03
Rayburn/Cafeteria	Pepsi	DN	Y	DN720P HVV-12	N		207.0	149.9	166.2	162.4	28%	2%	61.83	$65.00
Ford/Vending Room	Pepsi	DN	Y	DN720P HVV-12	N		195.1	145.9	146.9	155.2	25%	-6%	38.18	$40.13
Rayburn/Cafeteria	Coke Zero	Royal	Y	RVCC-660-8	N		228.8	188.5	200.3	208.9	18%	-4%	30.39	$31.95
Ford/Vending Room	Coca Cola	Royal	Y	RVCC-660-8	N		221.8	192.2	187.6	197.2	13%	-5%	18.34	$19.28
Longworth/Vending	Pepsi	DN	Y	DN720PHVV-12	N		263.9	214.9	226.6	219.2	19%	3%	57.57	$60.52
						Average of 17 Samples	226.0	177.4	185.6	179.3	22%	3%	56.18	$59.06

APPENDIX 3:
COMPLETE SET OF POWER USE AND LIGHTING DATA FOR A PEPSI VENDING MACHINE

PRODUCT: Pepsi | **MODEL:** DN720P-HVV-12 | **LOCATION:** Ford/Vending Room
UNIT MAKE: DN | **SERIAL NO:** SN78480028 | Recorded by Hobo Meter No. 2024008

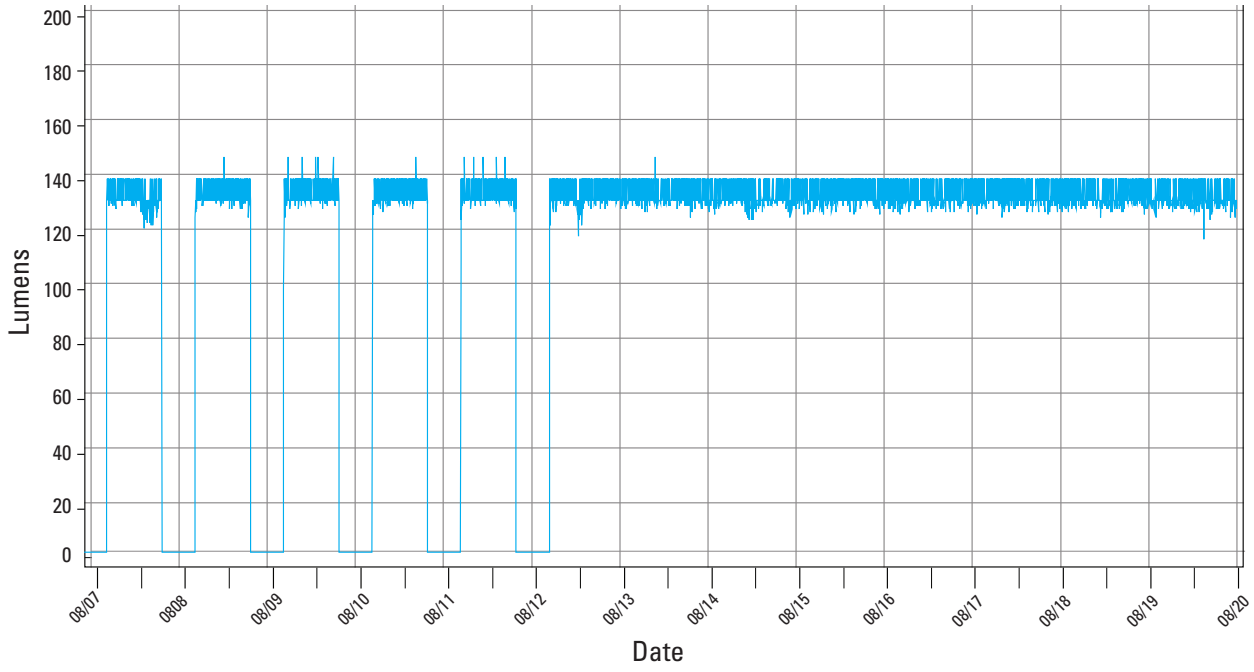


PRODUCT: Pepsi | **MODEL:** DN720P-HVV-12 | **LOCATION:** Ford/Vending Room
UNIT MAKE: DN | **SERIAL NO:** SN78480028 | Recorded by Watts Up Meter No. 1201



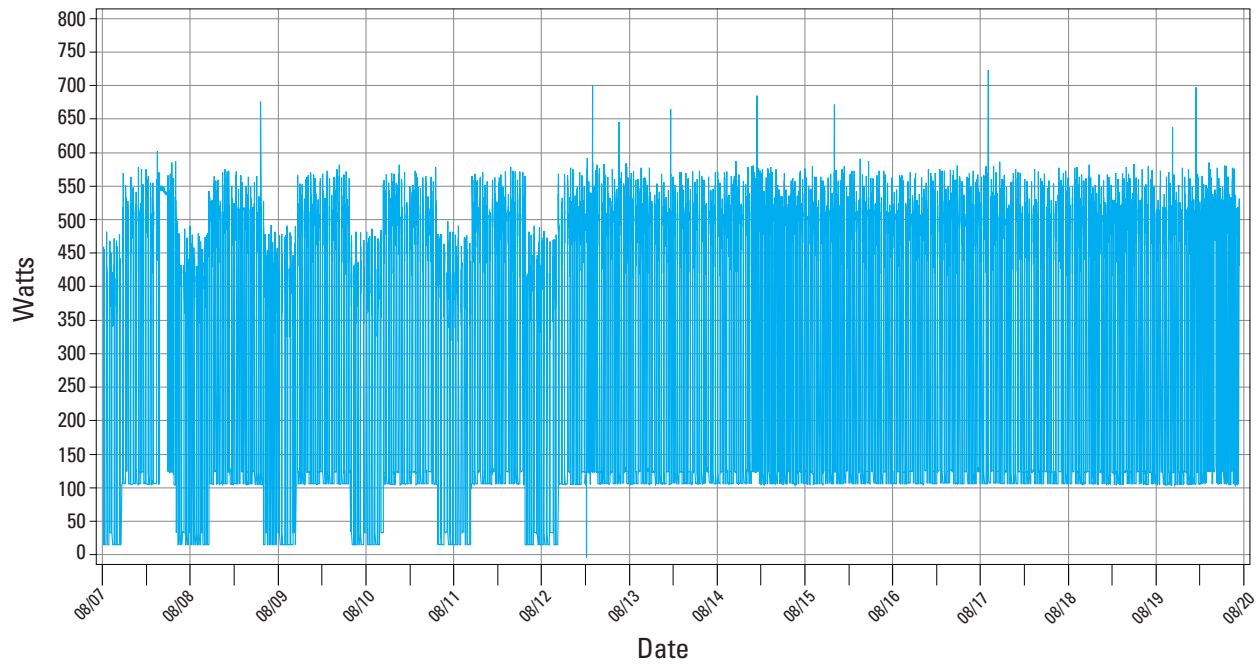
PRODUCT: Pepsi **MODEL:** DN720P-HVV-12 **LOCATION:** Ford/Vending Room

UNIT MAKE: DN **SERIAL NO:** SN78480028 Recorded by Hobo Meter No. 2024008

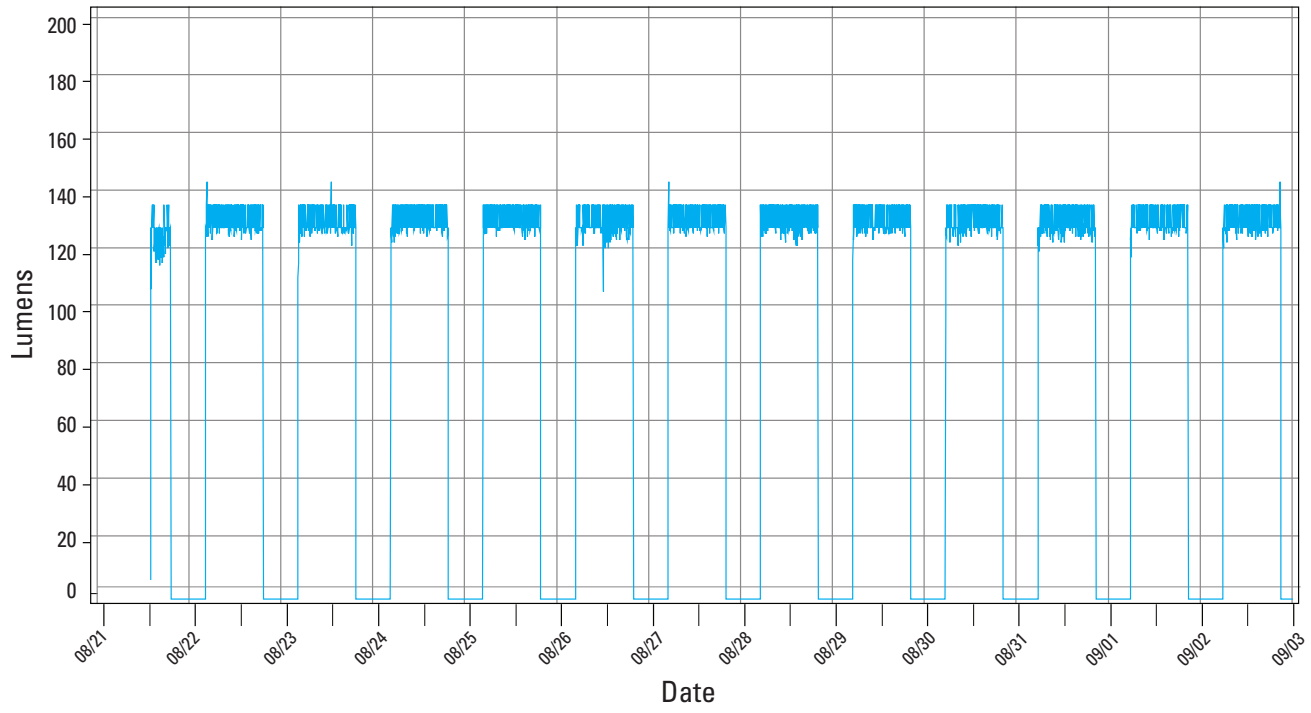


PRODUCT: Pepsi **MODEL:** DN720P-HVV-12 **LOCATION:** Ford/Vending Room

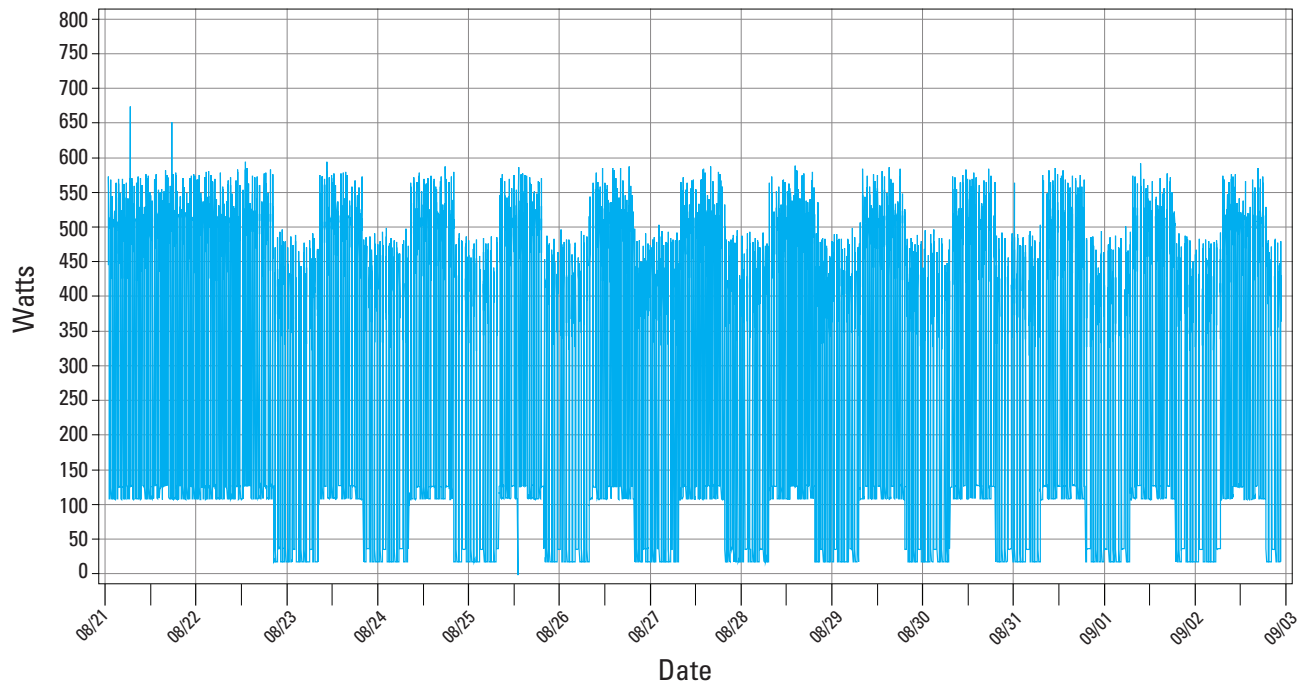
UNIT MAKE: DN **SERIAL NO:** SN78480028 Recorded by Watts Up Meter No. 1201



PRODUCT: Pepsi
UNIT MAKE: DN
MODEL: DN720P-HVV-12
SERIAL NO: SN78480028
LOCATION: Ford/Vending Room
Recorded by Hobo Meter No. 2024008

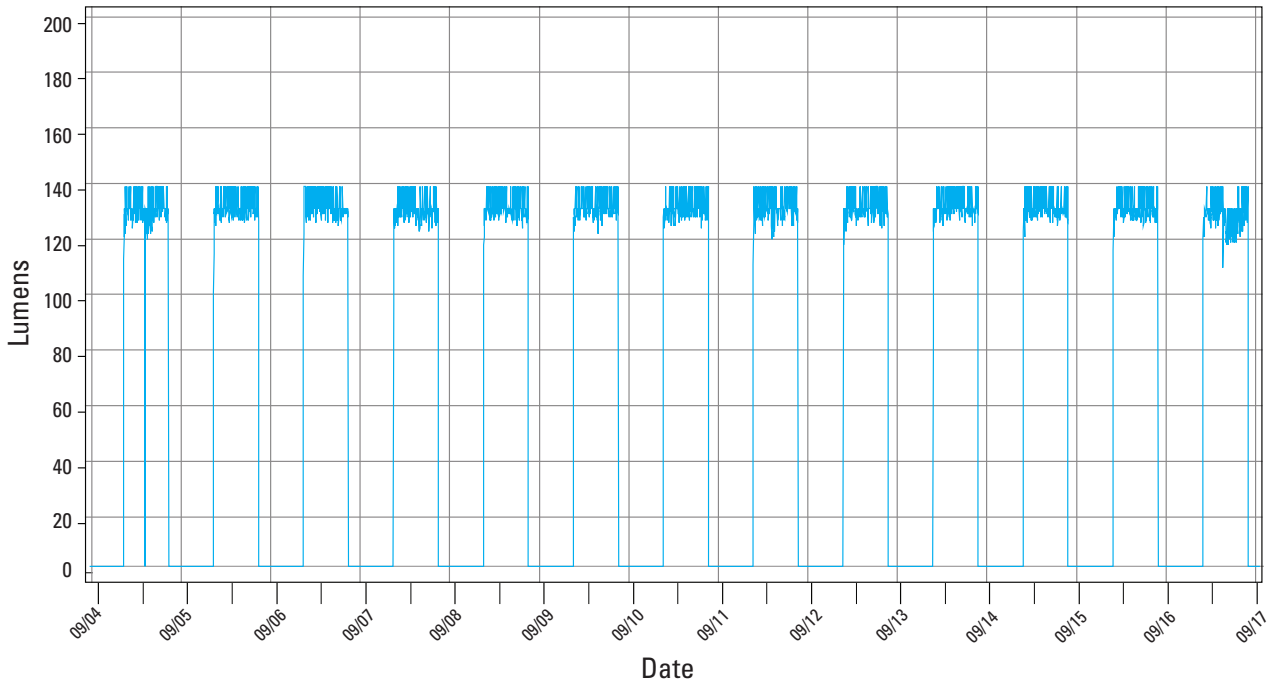


PRODUCT: Pepsi
UNIT MAKE: DN
MODEL: DN720P-HVV-12
SERIAL NO: SN78480028
LOCATION: Ford/Vending Room
Recorded by Watts Up Meter No. 1201



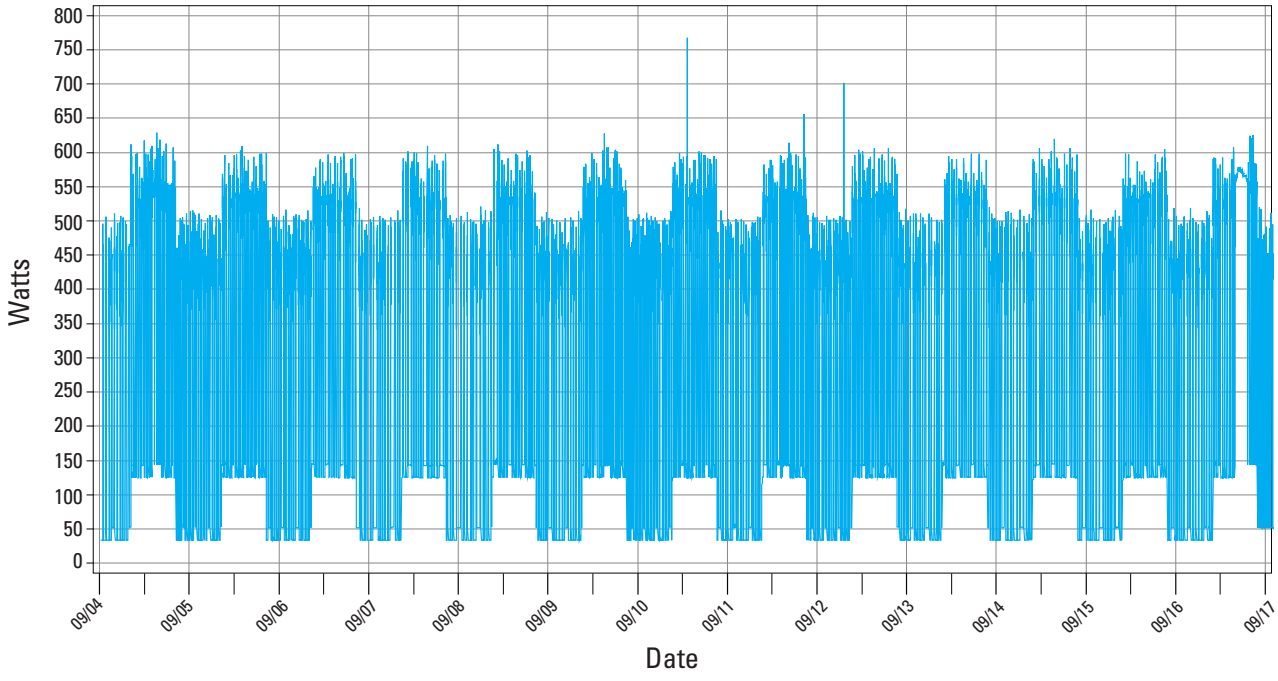
PRODUCT: Pepsi **MODEL:** DN720P-HVV-12 **LOCATION:** Ford/Vending Room

UNIT MAKE: DN **SERIAL NO:** SN78480028 Recorded by Hobo Meter No. 2024008



PRODUCT: Pepsi **MODEL:** DN720P-HVV-12 **LOCATION:** Ford/Vending Room

UNIT MAKE: DN **SERIAL NO:** SN78480028 Recorded by Watts Up Meter No. 1201



United States
Environmental Protection
Agency