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UNIVERSITY OF IDAHO
SUSTAINABILITY CENTER

Energy Efficient Vending Machine Upgrades

ENVIRONMENTAL AND ECONOMIC CONSIDERATIONS

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Purpose

The University of Idaho Sustainability Center conducted this vending machine assessment in accordance with the institution's commitment to ACUPCC (American College and University Presidents' Climate Commitment) and the institution's commitment to the UI Climate Action Plan (CAP). The CAP was developed to outline the steps the University of Idaho needs to take to become climate neutral by 2030. The steps towards climate neutrality are also steps towards greater fiscal responsibility, energy conservation, higher performance buildings, reducing fossil fuel use, and other strategies which are cost-effective, not only reducing our greenhouse gas emissions, but also reducing operational costs and the impacts of future increases in energy and fuel prices.

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Background

The University of Idaho campus is home to two different types of vending machines: refrigerated drink vending machines and snack machines. An inventory of existing machines on campus by Spencer Batt of the University of Idaho Sustainability Center in 2013 reported at least 127 of these machines on campus. When evaluated individually, vending machines represent a negligible amount of energy usage on campus; however, the sheer quantity of vending machines on campus necessitates further investigation.

Testing

While official specification sheets for each vending machine on campus generally include a voltage and current rating, these represent peak values only. For instance, Dixie-Narco reports that their 501E cold bottle drink vending machine (a common machine on campus) requires 11.0 Amperes at 115 VAC. These ratings would suggest that the 501E machine requires 1.265 kW to operate, which is a massive energy requirement. In most cases, no typical power usage value is reported by the company, making it difficult to predict the benefit, if any, of installing energy saving devices on these vending machines.

To determine the real world energy usage of vending machines on campus, two common model machines were monitored for energy usage. These two machines were the Dixie-Narco 501E and the Automatic Products 7600, each representing a typical refrigerated drink machine and non-refrigerated snack machine, respectively. Each machine was monitored for energy usage in January 2015 using a Kill-A-Watt P4400 meter for one week, in Shoup Hall. The time and energy data reported by the meter was used to calculate the average power usage and resulting estimated yearly power usage. These values assume that the temperature of Shoup Hall remains constant year round, which is a reasonable assessment since the building is heated. That said, it is likely that Shoup Hall is generally warmer during the Spring and Summer due to the building's lack of air conditioning; this means that the calculated values are conservative. Increased ambient temperature during warmer months will mean an increase of energy usage to keep the beverages of the refrigerated machine cool. The table below indicates the measurements for each machine and corresponding yearly energy usage:

Table 1: Energy Usage Statistics

	DIXIE-NARCO 501E	AP 7600
TIME ELAPSED	172 hrs	184 hrs
TOTAL ENERGY USAGE	62 kWh	11.73 kWh
AVERAGE POWER USAGE	0.36 kW	0.06 kW
ENERGY USED PER YEAR	3150.03 kWh	558.45 kWh

These calculations reveal that the refrigerated vending machine, the Dixie-Narco 501E, uses a substantial amount of energy every year even by itself. The non-refrigerated machine, by comparison, uses very little.

Energy Saving Devices

One common method to reduce vending machine energy usage is the installation of regulating devices on the machine. Perhaps the most well-known solution is offered by the company EnergyMisers. The device they offer is called a VendingMiser, and once installed on the vending machine, it regulates power usage via a timer and an occupancy sensor. The occupancy sensor detects when the area surrounding the vending machine is vacant and powers down the machine accordingly. In addition, the timer powers down the cooling system at set intervals while still ensuring that the product is cold.

Cost Analysis

EnergyMisers recommends the VM150 VendingMiser for refrigerated vending machines. The company reports that energy is reduced by 46% on average after installing these devices on the machines. Other benefits that the company reports includes, longer machine lifespan and universal compatibility with all types of vending machines.

The University of Idaho subscribes to Avista Utilities' schedule 25 for electric service. Given the university's power usage, the university is billed exactly $0.04414 for each kWh of energy use. In addition to the energy charges, the university is also billed for peak demand each month at a rate of $4.50 per kVA above 3000 kVA. The university's power usage is consistently well above the 3000 kVA cutoff, so every kVA (which is in this case synonymous with kW) of demand that the VendingMisers reduce will reduce the monthly fee by $4.50.

Using this data, the cost savings and internal rate of return (IRR) for a 10 year period can be calculated. Installing VendingMisers will also have the added benefit of reducing the university's peak power draw since at any given time, some of the machines will be off. The exact amount of peak demand reduction is difficult to quantify, because it depends on the pattern of occupancy in the buildings. For this reason, the IRR including a 46% reduction in peak demand from the machines is calculated in addition to an IRR without this reduction. Both sets of figures are shown in Table 2. Non refrigerated vending machines are also not taken to account since their average power usage is substantially less than refrigerated ones. For the rest of this report, only the Dixie-Narco 501E energy machine, representative of typical refrigerated vending machines on campus, will be considered.

Table 2: Cost Analysis

	Dixie-Narco 501E
Machines/Campus	82
Total Energy Usage	258303
VM150 Vending Miser Cost	$123.49
Demand Charge per kVA	$4.50
Energy Charge per kWh	$0.044140
Average Energy Reduction Factor	46%
Implementation Cost (product only; no labor)	$10,126.47
Estimated Energy Saved Per Year	118819
Estimated Energy Charge Savings Per Year	$5,244.68
Estimated Demand Reduction	14.0
Estimated Demand Charge Savings Per Year	$756.00
Total Savings Per Year	**$6,000.68**
10 year IRR (without demand reduction)	**51%**
Years to break even (without demand reduction)	**1.93**
10 year IRR (with demand reduction)	**59%**
Years to break even (with demand reduction)	**1.69**

Regardless of whether the demand charge reduction is included, the savings are easily seen, and will be realized in less than two years not including the labor charge for installing the misers. The retail price of each vending miser is $189.99, but when buying directly from EnergyMiser, a 35% bulk discount can apply (February 2015).

Environmental Impact

As with many energy saving initiatives, this project will have a notable environmental benefits. The United States Environmental Protection Agency (US EPA) has developed an "emission factor" which equates energy used (in kilowatt-hours) to metric tons of carbon-dioxide (CO_2), one of the chief identified greenhouse gases. Table 3 indicates the conversion factor and the amount of metric tons of CO_2 saved each year as a result of implementing these VendingMisers.

Table 3: Greenhouse Gas Reduction

CO_2 Generated Per kWh Used	6.89551 x 10^{-4} metric tons
Energy Saved with Vending Misers	118819 kWh
CO_2 reduced	81.93 metric tons

In addition to reduced emissions, EnergyMiser reports that the VM150 Vending Miser increases the lifespan of its host machine by reducing the amount of time the compressor is on.

Alternatives and Conclusion

Installing VendingMisers on old vending machines is an effective way to reduce power consumption. However, many modern vending machines are Energy Star certified. According to Energy Star, vending machines that have earned this certification are 50% more efficient than standard refrigerated beverage vending machines. This is even greater the average 46% energy reduction that is realized with the installation of VendingMisers. While replacing all the beverage vending machines currently on campus with Energy Star approved models would be cost prohibitive, requiring that future vending machines be Energy Star approved would greatly improve efficiency.

Refrigerated vending machines on the University of Idaho campus consume a surprisingly large amount of energy every year. The economic and environmental benefits of upgrading campus vending machines are quickly realized, and the only drawback is the somewhat substantial initial cost of installation. An estimated maximum of 1.93 years will be needed to observe a full return on the investment, even neglecting the peak demand reduction. Overall, the results from this study present a strong case for implementing Vending Misers on University of Idaho refrigerated beverage vending machines as soon as possible.