



## **The VendingMiser:**

### **A Pilot Study Of Its Use at the University of Illinois at Urbana- Champaign**

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## The situation

- Vending Machines at the University of Illinois at Urbana-Champaign are constantly lit and in operation, keeping their products cold and “in your face” as you pass by the machine at any given time. With roughly 400 Coca-cola machines on this campus alone, these machines cost the University of Illinois thousands of dollars each year in electricity bills. With an increased interest in sustainability and budget reductions the university must find solutions that reduce costs as well as fossil fuel emissions. The vending miser is a solution that solves both problems.



## The precedent

- **CLEAN!**
  - Tufts University began an effort in 1990 to reduce or eliminate environmental impacts from the University's own operations. Known as CLEAN! (Cooperation, Learning, and Environmental Awareness Now!), this effort was led by a team of faculty, staff researchers, and students. This team gathered information and made recommendations about changes that Tufts University could make to reduce its burden on the environment.





## Tufts Climate Initiative

- What began as CLEAN!, continues as the *Tufts Climate Initiative* (TCI). As a part of TCI the President of Tufts made a commitment in April 1999 to meet, or beat, the Kyoto goal of a 7% reduction below 1990 levels in carbon dioxide emissions by the year 2012.



# TCI Activities

- **The Tufts Climate Initiative works with university faculty and students in 4 ways.**
  - **Acting to reduce CO2 emissions**
  - **Research and monitoring of energy and emissions**
  - **Including content in courses and student projects**
  - **Engaging in outreach activities promoting sustainable practices, such as energy and resource efficiency.**



# One TCI Initiative

- Energy Efficient Vending Machines
  - Tufts evaluation research of the VendingMiser
    - measured the electricity used by a refrigerated beverage machine in a dormitory building for one typical week before and after installation of a VendingMiser.
    - found predicted savings from this one machine are at least \$192/year, which would likely be higher than this because the annual calculation assumes that the dorm is occupied throughout the year. Vacation savings would be substantially higher.

	Without VendingMiser	With VendingMiser
Monitored period	1 week	1 week
Electricity use	66.71 kWh	33 kWh
Electricity Cost (\$0.11/kWh)	\$7.34	\$3.63
Implied cost per year	\$381	\$189



## Would the VendingMiser be Effective at UIUC?

- A team of graduate students in Architecture conducted research to further evaluate the VendingMiser by examining,
  - Two building types
  - Week days and weekend days





## Two building types

- Temple Hoyne Buell Hall is a mixed use building in the center of campus. It contains the administrative offices for 3 academic units, a large auditorium, lecture rooms, design studios, and faculty offices. Students have access to the building 24 hours a day and speak often of being there all night.
- Waste Management and Research Center is laboratory and office building. It is located on the periphery of campus. There is monitored access between the hours of 8-5. There is very limited occupancy outside of these hours.

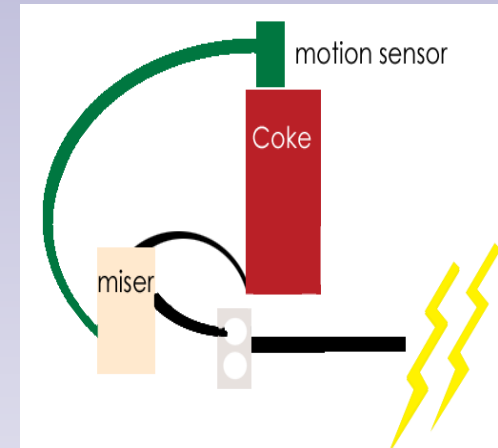






# The Miser

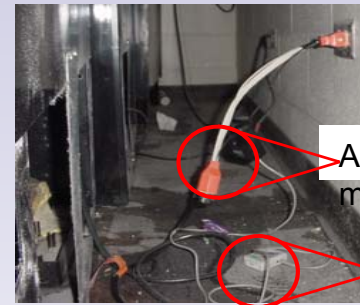
- The VendingMiser consists of two elements:
  - A controller element that regulates the flow of electricity to a vending machine.
  - A passive infrared sensor monitors occupancy in the space adjacent to the vending machine.
- The controller interrupts the electricity after 15 minutes of inactivity around the sensor.
- The controller starts the vending machine periodically to maintain cold beverages





# Monitoring the Miser

- The Miser was plugged directly into the wall socket used to power the vending machine. A short (about 24") line cord separated the 3 wires providing AC to the vending machine. An AC monitor was clamped over one of the wires in the line cord and was attached to a HOBO data logger. The vending machine was then plugged into the extension cord in order to provide power to the vending machine. This set up allowed us to monitor the amount of current the vending machine used and when the vending miser cut the power to the machine. Taking measurements for a one-week time period at each location, we can then extrapolate the data to determine how much energy the machine used over a month/year time frame.

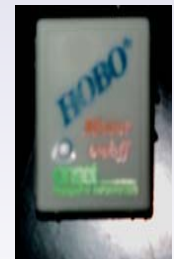


Split extension cord.

AC monitor clamp, which measures the current.

HOBO, which collects the data.

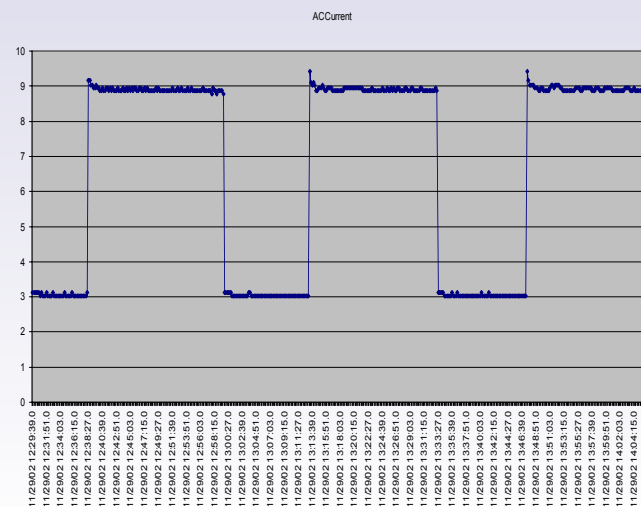
- To determine when a person bought a Coke we placed a vibration sensor data logger immediately below the slot of the machine. We adjusted the sensor to vibration from the compressor and coins entering the machine and to only register the bottles falling down into the slot.
- We used this setup for one week and Temple Buell and recorded the data from there. After that we moved the vending miser to WMRC and ran the setup for another week to gather data to compare with the TBH results.





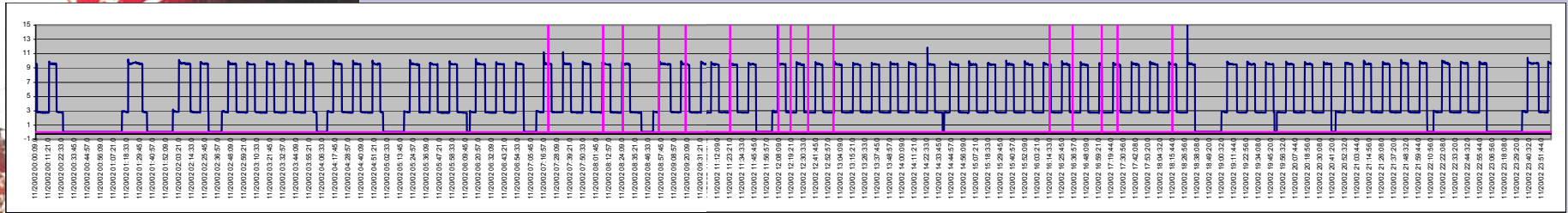
# Base measurement

- This segment of data collected from one of the tested vending machines shows the basic cycle of operation. The compressor cycles off and on, the backlights are on continually.
- In this example, one cycle saw the compressor on for about 20 minutes, then off for the next 15 minutes.



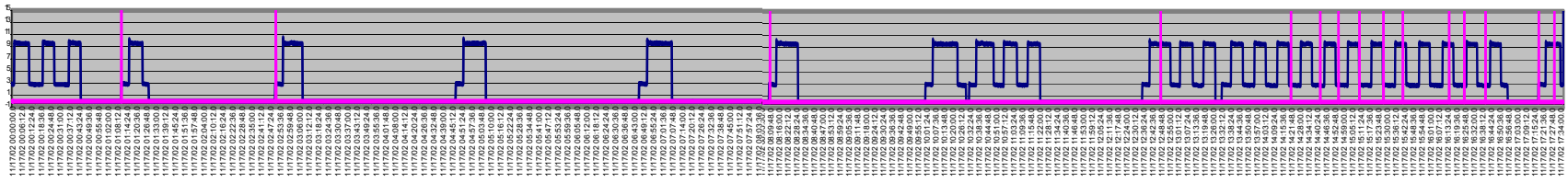


# A weekday at THBH



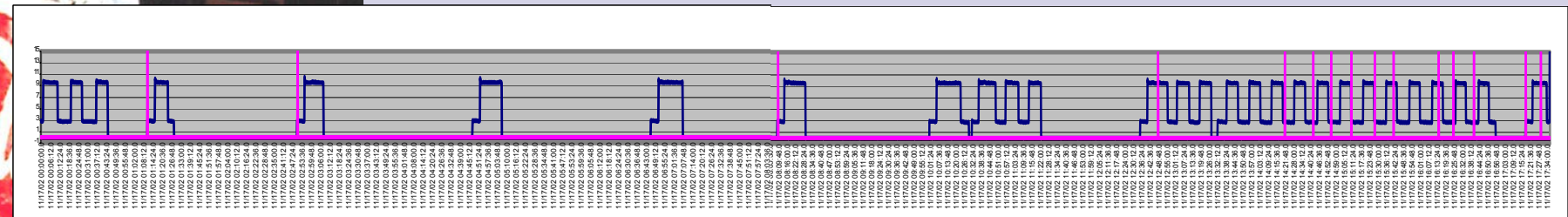
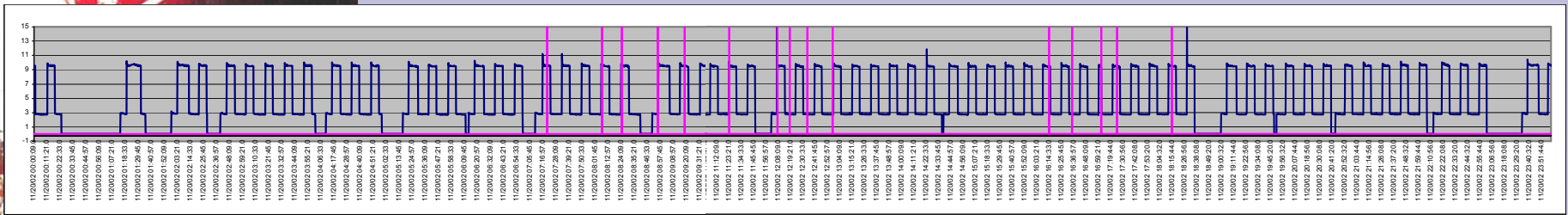
As the data shows, the THBH vending machine is consistently in operation throughout the day except the period between two o'clock a.m. and seven o'clock a.m. Because of the frequent presence of people around the sensor, the miser does not often start a “rest period”.

# A Sunday at THBH



- The pattern changes on the weekends. Here the VendingMiser has a higher impact. Still the occupancy sensor appears to activate the vending machine for 3-4 sales.

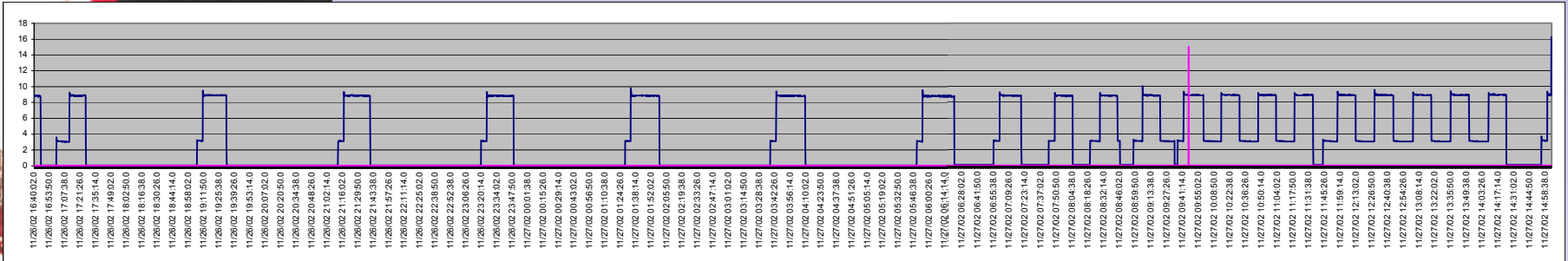
# Two days at THBH



- The VendingMiser appears to make a difference in electrical consumption when the 24 hours of a weekday are compared to the 24 hours of a Sunday.
- Over the course of a year, it is likely that vacation periods, and the summer months, look more like the pattern on Sunday than the weekday.

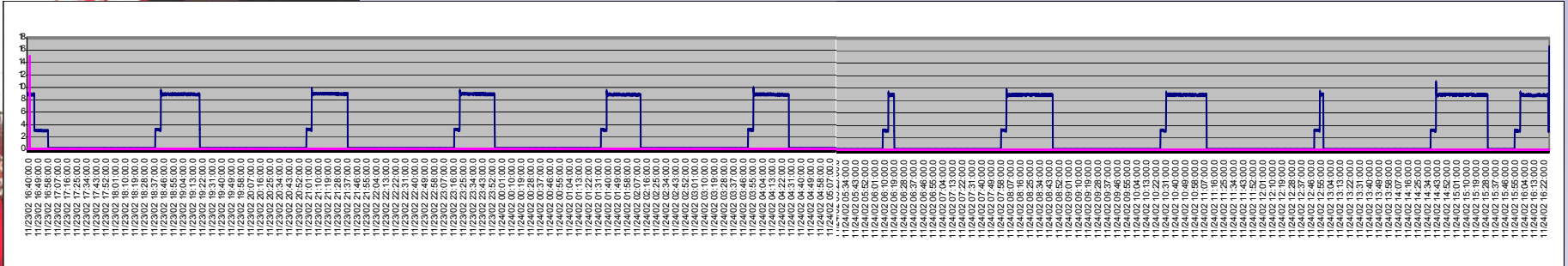


# A weekday at WMRC



Unlike the data from THBH, the data shows the potential for substantial savings on energy costs by using a VendingMiser. Because of the nature of this facility, which opens its door at eight and closes approximately five o'clock, individuals are not around to use the vending machine for during the night, thus providing the vending miser an opportunity to turn off the machine for extended periods of time. On this week day only one beverage appears to have been purchased.

# A Sunday at WMRC





# Savings at THBH

- Savings at THBH were calculated on a daily basis and ranged from a low of 11.6% to a high of 29.8%. The average savings over this period was 22%.
- Using a value of 0.055 per kilowatt hour, the implied daily savings from the VendingMiser is \$0.20. Over a year this would be \$74. Considering the cost of the device to be about \$180, the payback would occur in about 2.5 years

Date	Base kWh	Actual kWh	Base Cost (at \$0.055)	Actual Cost (at \$0.055)	% Savings
11/13/02	16.4	11.5	0.902	0.6325	29.88
11/14/02	16.4	13.3	0.902	0.7315	18.90
11/15/02	16.4	12.4	0.902	0.6600	24.39
11/16/02	16.4	12.0	0.902	0.6820	26.83
11/17/02	16.4	11.1	0.902	0.6105	32.32
11/19/02	16.4	13.1	0.902	0.7205	20.12
11/20/02	16.4	13.8	0.902	0.7590	15.85
11/21/02	16.4	14.5	0.902	0.7975	11.59

Note: data for 11/18/02 was lost when the VendingMiser was unplugged.





## Savings at WMRC

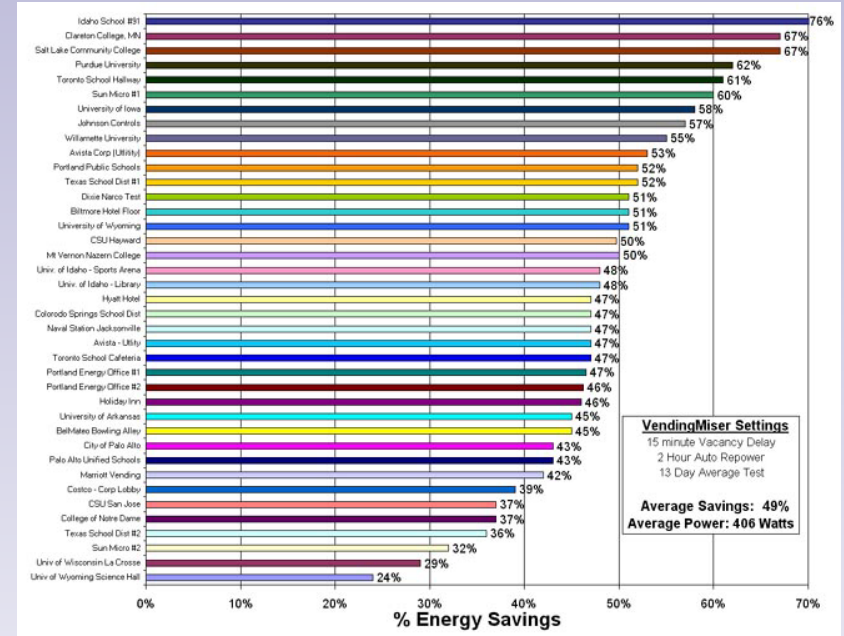
- Savings at WMRC were calculated on a daily basis. These ranged from a low of 31% to a high of 64%. The average daily savings is 43%. This implies an average daily savings of \$0.39 and an annual savings of \$143.13.
- With the cost of the VendingMiser around \$180, the payback is approximately 1 year and 3 months.

Date	Base kWh	Actual kWh	Base Cost (at \$0.055)	Actual Cost (at \$0.055)	% Savings
11/21/02	16.4	11.3	0.902	0.622	31.0
11/22/02	16.4	6.9	0.902	0.380	57.8
11/23/02	16.4	6.5	0.902	0.358	60.3
11/24/02	16.4	10.2	0.902	0.561	37.8
11/25/02	16.4	7.2	0.902	0.396	56.1
11/26/02	16.4	8.2	0.902	0.451	50.0
11/27/02	16.4	5.9	0.902	0.325	64.0
11/28/02	16.4	7.0	0.902	0.385	57.3



# Summary of other evaluations

- Several evaluations of the Miser have been conducted, in addition to the study at Tufts. Bayview Technology, the manufacturer of the VendingMiser, has provided this summary of these.
  - THBH savings are similar to the Science Hall, University of Wisconsin.
  - WMRC savings are similar to those of the City of Palo Alto.





## Conclusions

- It would make the most economical sense to place Vendingmisers administrative buildings, and others where the hours are clearly 8 to 5.
- The building such as Temple Buell doesn't allow the miser to sleep for any extended amount of time.
- Still, a Vendingmiser would be able to help reduce costs on any vending machine.
- The University should pursue a program of introducing Vendingmisers on the UIUC campus.