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Product & Technology Review

CoolerMiser™

A device that controls the operation of stand-alone beverage coolers based on occupancy of the surrounding area.

Product

- CM150 – CoolerMiser with PIR Sensor
- CM170 – CoolerMiser with PIR Sensor and Easy-Install
- CM2iQ – Requires Internal Installation

Manufacturer

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Product History

USA Technologies (under their original name, Bayview Technology Group) first developed VendingMiser, a device to reduce energy use of refrigerated vending machines during periods of low occupancy. Its performance has been documented in numerous case studies and testimonials, and it was incorporated into many utility incentive programs in the Northwest. USA Technologies then adapted this technology to other applications including SnackMiser™, PlugMiser™, and CoolerMiser™. CoolerMiser was introduced in 2003 and the

Photograph courtesy of USA Technologies.

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CM2iQ model was added in 2005 to provide greater control for customers able to install the unit within the cooler.

Product Function and Application

The following information was provided by the manufacturer and is not evaluated here. Note that in this factsheet we will refer to models CM150 and CM170 as "CoolerMiser," and refer to the model that requires internal installation as CM2iQ.

Photograph courtesy of USA Technologies.

The CoolerMiser controls the operation of glass-front self-contained beverage coolers (similiar to the one pictured above – also known as "merchandisers" and not to be confused with refrigerated vending machines) by using a passive infrared (PIR) sensor to detect occupancy around the cooler. When the surrounding area has been vacant for 15 minutes, the CoolerMiser will consider powering down the machine to standby mode (1-2W). At this point the product's internal intelligence kicks in.

The CoolerMiser records the compressor ON and OFF times and uses this information to monitor the cooling needs of the machine. For example, if the cooler has been operating with 10-minute ON-times with 20 minutes between cycles, and then has a two-hour ON time, the CoolerMiser interprets this as the door being open for an extended period (e.g., as drinks are restocked) and will not enter the standby mode until the compressor cycle times have stabilized.

Once in a stable mode of operation, the CoolerMiser monitors the room temperature and compressor cycle ON and OFF times to calculate the length of time the cooler can spend in standby mode before it must be re-powered in order to maintain product temperature. This ranges from one to seven hours; the warmer the room the shorter the time. CoolerMiser's electrical current sensor eliminates compressor short cycling – it will never power down the machine while the compressor is running. And when the machine is powered up, the cooling cycle is allowed to finish before being powered down, reducing wear and tear on the compressor.

Because cooler doors are open for various lengths of time while customers choose beverages, the recovery and compressor cycle times vary much more than on a vending machine; therefore CoolerMiser has to be a more sophisticated product than VendingMiser.

The CM2iQ works a bit differently. The CM2iQ uses a microphone to detect the cooler door opening rather than monitoring occupancy in front of the cooler, so the cooler may be in energy-saving mode even while people are walking by (and therefore spends more time in an energy savings mode). The CM2iQ also monitors the internal temperature of the cooler – and the rate of change in temperature – to better determine the optimum length of the energy savings period. In energy savings mode, if the temperature gets too high, the CM2iQ cycles the evaporator fans as needed. These fans circulate stagnating air. When air recirculation alone is inadequate to maintain the desired temperature range, the CM2iQ ends the energy-saving mode.

Key differences between the models include:

- A cooler with CM2iQ may be in standby mode even while people are walking by, and therefore spends more time in an energy savings mode than a cooler with CoolerMiser.
- CoolerMiser shuts down lights and fans for the duration of standby mode while CM2iQ leaves lights on and cycles the evaporator fans to extend the period

Chart 1

Typical Saving Generated with CoolerMiser™

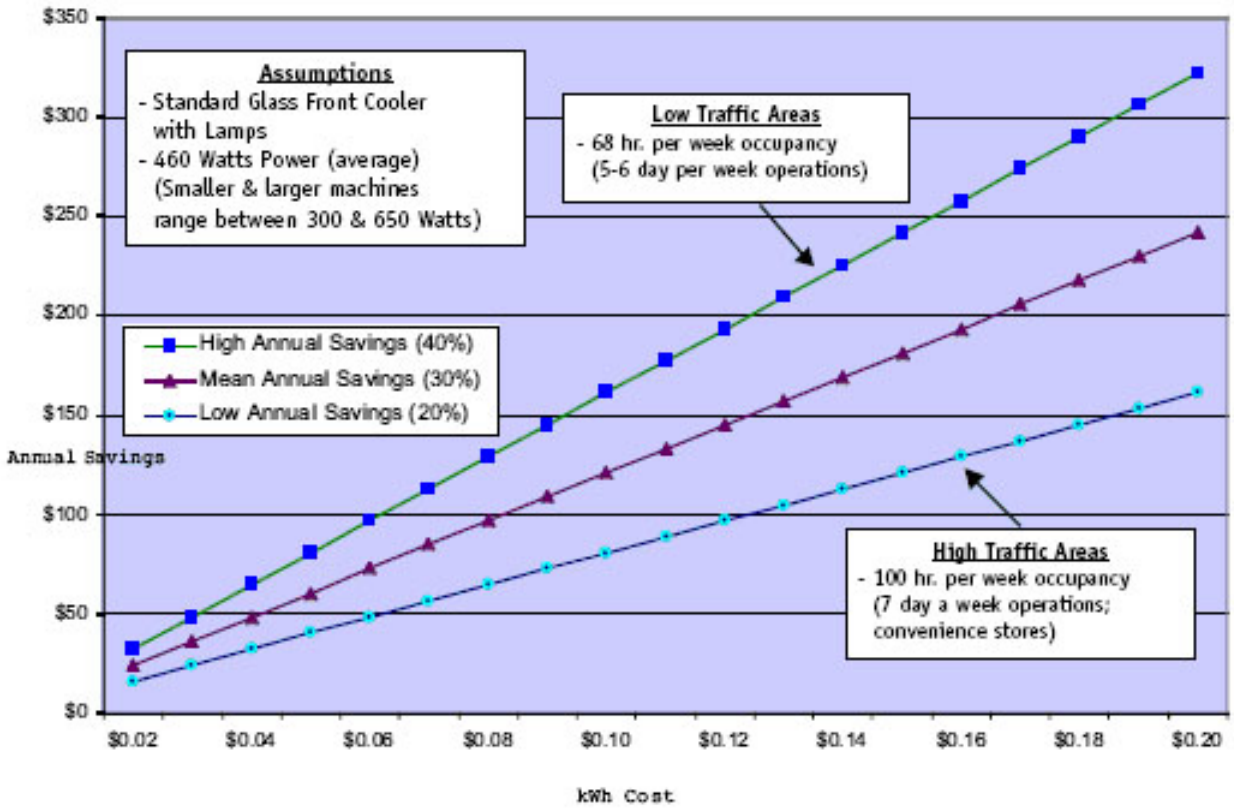

Chart courtesy of USA Technologies

that the compressor doesn't operate.

- CM2iQ tracks a cooler's internal temperature, resulting in smaller temperature variations.
- CM2iQ is installed internally so is not prone to vandalism or disabling.

CoolerMiser and CM2iQ are compatible with self-contained coolers (rather than banks of coolers running off one or more remote compressors) containing non-perishable products (typically drink bottles) with up to three sliding or hinged glass doors. The best applications are coolers located in areas with low occupancy rates, such as schools. CM2iQ is the better choice for applications such as the checkout line of a 24-hour supermarket where there may be regular occupancy but infrequent sales, but CM2iQ is only compatible with applications where internal cooler wiring can be modified.

CoolerMiser is a small, plug-and-play device that installs in minutes. CoolerMiser is 4.5"W x 1.75"H x 3.25"D and weighs just over two pounds, including power cable. It can be installed on the wall with simple hand tools, or without tools using the Easy-Install system. The CM2iQ is a 3" box that can be installed inside the cooler in 10-15 minutes by a qualified technician.

For applications where there are multiple vending machines side by side (each with its own compressor), one PIR sensor can control several machines using CoolerMiser, SnackMiser, or VendingMiser. A sensor repeater is already built into the Miser products, so additional hardware is not required.

The maximum steady-state load controlled by all three models is 12 Amps. The power consumption of CoolerMiser is less than two

watts in standby mode. The devices are UL/C-UL Listed.

Energy Savings Claims

Both CoolerMiser and CM2iQ can save an average 35% of energy costs or about $100 per year per cooler.

Non-Energy Benefits

All three models enable coolers to operate less, thereby extending expected lifespan and decreasing the frequency of required equipment maintenance and replacement. However, because self-contained coolers are most commonly provided to retailers at no cost by beverage companies, the equipment cost savings would benefit the beverage companies rather than the retailers.

A 1998 study by USA Technologies (under their previous name, Bayview Technology) concluded that reduction in maintenance and repair costs resulting from the installation of a VendingMiser is about $44/year. While this wasn't an independent study and it was VendingMiser rather than CoolingMiser, it was well documented and it is still helpful to have additional data that agrees with the independent testing noted below.

Independent Testing Results

Tandem Technologies, a small engineering firm that primarily does product development and testing for PepsiCo, tested the CM2iQ device with a small (12 cu.ft.) Beverage-Air MT-12 cooler. The cooler was first tested with the standard manufacturer-installed thermostat and then with the CM2iQ device. The report (see References) noted no significant energy savings during an 8-hour occupied period, but 14.7% energy savings for a 16-hour unoccupied period. This report found that the cooler used about 6.1 kWh per day without CM2iQ, so the savings translated to about $33/year. The report also found that the minimum, maximum, and average temperatures with CM2iQ were all within a degree of those without CM2iQ.

An engineering report in 2000 by Foster-Miller, a large technology and product development company, analyzed the energy savings of VendingMiser, which is a similar product used in a similar application. This report concluded that use of VendingMiser cut energy costs by 48% ($88/yr at $0.10/kWh) for an application with no occupancy for 50% of the time.

A 2002 report by Foster-Miller analyzed potential annual savings on maintenance and repair costs due to installing a VendingMiser on a beverage machine in a retail store. The assumptions included maintenance/repair savings from the compressor, evaporator fans, thermostat, lighting, and electronic controls in addition to preventative maintenance. The savings ranged from about $45 to $57, with higher savings for a store without weekend hours and with a partially full cooler.

Case Studies

Austin Energy offers their customers CoolerMisers at no cost and has funded 500 installations. They monitored energy use for at least 20 CoolerMiser installations for a week and determined that the average energy savings was about 35%, or $100.

USA Technologies lends data loggers to customers to monitor energy consumption for a week at one minute intervals. The specific conditions of these tests are not known. Four of the data summaries (selected by the manufacturer) are as follows:

Customer	*Average Energy Savings*	
Blue Moon Floral Shop	36%	$122/year
Blockbuster	33.3%	$98/year
Dakota Electric	39.5%	$124/year
Chipotle Mexican Restaurant	37%	$170/year

Puget Sound Energy staff monitored the internal temperature of a cooler in a pizza shop using the standard cooler thermostat, CoolerMiser, and VendingMiser. The temperature fluctuation with the cooler thermostat was within 1°F, while the fluctuations with CoolerMiser and VendingMiser were about 2.5°F. They found that the annual energy savings from using CoolerMiser was about half

of that from using VendingMiser (850 kWh vs. 1575 kWh), but the peak temperatures were significantly less with CoolerMiser (45.1°F vs. 49.4°F, compared with 42°F using the cooler thermostat). There was a concern that this higher peak temperature would result in the product's temperature not recovering in time for the customer's arrival, but at this particular shop the cooler was stocked two hours before the store opened, which provided ample time for temperature recovery. So in this case it seems that VendingMiser may actually be a better choice, but using VendingMiser on a cooler is very application-specific, so should be considered with caution.

Cost

The cost is $160 for a CoolerMiser with PIR sensor and the Easy-Install kit, and $112 for the CM2iQ. The cost would be lower in both cases for purchasing a greater quantity. Installation labor of approximately 5-15 minutes would be added to the cost.

USA Technologies is a General Services Administration (GSA) contractor on Schedule 70, so federal, state, and local government agencies can purchase CoolerMiser at premium, pre-negotiated rates.

Utilities may also provide incentives. The EnergySmart Grocer program (funded by the Bonneville Power Administration and operated by Portland Energy Conservation, Inc.) installs CoolerMisers free of charge within the service territories of 67 Northwest utilities to generate energy savings and build interest in other measures of the program. Pacific Power offers their customers $75 per unit.

Alternative Products and Strategies

No other products seem to do what CoolerMiser and CM2iQ do. The closest may be VendingMiser, which also powers down a machine but allows a higher peak temperature and a longer recovery time, as noted under *Case Studies* on page 4.

A cooler could be plugged into a power strip with an occupancy sensor, which is made by more than one manufacturer, but that would simply cut all power to the unit for the duration of the unoccupied period regardless of room or product temperature and would cut power regardless of compressor cycle operation, which isn't good for a compressor.

Almost all vending machines purchased from now on will be Energy Star Tier 2 models that incorporate features of VendingMiser in addition to variable speed compressors, high efficiency lighting, and other features. It could be that cooler manufacturers will soon follow suit in incorporating these features in new coolers, but CoolerMiser may continue to be an attractive option for older coolers.

Suggestions for Further Research and Testing

The only independent testing report available is for the CM2iQ. This report seemed very thorough and professional, but the manufacturer believes it may be somewhat flawed. Other tests were for VendingMiser, which is a similar but different product and application.

Independent, side-by-side testing of CoolerMiser and CM2iQ should be performed in a variety of controlled conditions simulating typical applications. CoolerMiser and CM2iQ function in notably different manners. The CoolerMiser monitors occupancy to determine when standby mode is appropriate, measures room temperature to determine the duration of standby mode, and shuts down lights and fans for the duration of the standby mode. The CM2iQ monitors cooler door movement to determine when standby mode is appropriate, measures both room and internal cooler temperatures to determine the duration of standby mode, leaves lights on and cycles the evaporator fan to extend the period during which the compressor doesn't operate. As a result of these different control strategies, coolers with CM2iQ typically spend more time in standby mode (an average of about 60% more time according to the manufacturer) but the lights operate continuously and the evaporator fans periodically, both using

energy and contributing to the cooling load. It's unclear how energy savings generated from these two control strategies compare for various applications.

Independent testing should also monitor product temperature fluctuations before and after CoolerMiser is installed for a variety of room temperatures, occupancy rates, and cooler types to see how effectively the product's internal algorithms estimate allowable duration of time the machine can be powered down. Finally, it would be good to have estimates of equipment maintenance and repair cost savings for both CoolerMiser and CM2iQ.

Additional Reviewer Comments and Analysis

The potential impact of the three CoolerMiser models on Northwest energy use is significant. A recent market characterization study found that the roughly 120,000 beverage vending machines in the Northwest consume approximately 400 million kWh annually and contribute up to 40 MW demand; USA Technologies estimates that there are even more stand-alone coolers than beverage vending machines. The type of coolers appropriate for application of the devices are ubiquitous, particularly at convenience stores, grocery stores, discount stores, auto parts stores, video stores, and more – all running lights and evaporator fans 24/7 regardless of occupancy and cooling needs.

While the focus of this assessment is energy savings, the non-energy benefits (including product temperature control and impact on maintenance and repair costs) are also important for the long-term, widespread adoption of this technology in the region.

Energy:

It's hard to compare various estimates of energy savings due to variations in cooler types and sizes, occupancy patterns, and utility rates. Larger machines use more energy and will show higher savings. Savings will be higher for machines in low-traffic areas, or in places where they go unused for long periods. For example, the Tandem Technologies estimate noted under Independent Testing is for a 12-cu.ft. cooler, while the Chipotle estimate noted under Case Studies is for a 45-cu.ft. cooler. The customer case studies by both USA Technologies and Austin Energy both estimate average savings of 35% worth $100 per year or more. The independent testing by Tandem Technologies estimates savings of the CM2iQ at only 14.7% or about $33/year (for a small cooler). In both these cases, the cost savings aren't as important as percentage energy savings because cost savings are greatly influenced by local utility rates and cooler size.

The deemed savings determined by the Northwest Power and Conservation Council's Regional Technical Forum is 673 kWh/year, worth about $34/year at $.05/kWh and $67/year at $.10/kWh. The energy savings from using VendingMiser on a cooler would be more (roughly double according to brief field monitoring by Puget Sound Energy), but this comes at the cost of higher internal peak temperatures and a longer recovery time after restocking.

To fully assess the value of the saved energy, it would also be important to determine how much of the year the building where the cooler is located is in heating and cooling modes. Cutting the energy use of beverage coolers will reduce a building's cooling load, but add to their heating load. Thus, actual payback will depend on quantity discount, cooler size, utility rate, and occupancy pattern as well as climate and HVAC equipment efficiency.

Temperature:

While some fluctuation in product temperature is natural in a cooler with a cycling compressor and opening doors, it's important that product temperature isn't sacrificed to energy efficiency gains. Independent testing determined that the product temperature using CM2iQ was within a degree of minimum, maximum, and mean temperatures using a conventional thermostat. Lab testing by USA Technologies shows the two sets of temperatures were within about two degrees of each other. A graph of temperature fluctuations from field

monitoring by Puget Sound Energy shows peak temperature with CoolerMiser rising about 3°F above the peak temperature using the cooler thermostat. CoolerMiser doesn't monitor internal temperature but rather uses algorithms to estimate the time during which the entire machine can be powered down (with a given room temperature) without adversely impacting product temperature. The only testing of how successfully this is accomplished was performed by the manufacturer and Puget Sound Energy's brief field monitoring.

It is unfortunate that the CoolerMiser has the burden of keeping all beverages – even those on the top shelf – at the proper temperature for sale, therefore limiting the energy savings achievable. This is in contrast to VendingMiser, which can allow the temperature of many beverages to rise while the lowest beverage containers, first to dispense, may actually be cooler than usual due to stratification of air. Recovery times after restocking are longer with VendingMiser partly because CoolerMiser won't go into standby mode until compressor cycles have stabilized after restocking and VendingMiser will.

Non-energy Savings:

There was good agreement between the manufacturer's calculations and independent calculations of maintenance and repair savings, although both were for VendingMiser. The small difference in these two calculations could be easily explained by the difference in dates of the study – $44 in 1998 and $45-57 in 2002. Actual non-energy savings will be somewhat different for CoolerMiser and CM2iQ, and will vary with labor and utility rates, hours of operation, and equipment costs. Given that calculations focused on components also found in coolers (compressors, fans, thermostats, lights), it may be reasonable to assume that equipment cost savings for CoolerMiser and CM2iQ may also be in the range of $50/year. As noted above, self-contained coolers are usually supplied by beverage companies, so hopefully this equipment cost savings may help gain their support for installing the devices.

In addition to technical aspects of the products, there are application considerations to be addressed before market penetration can be achieved. According to the manufacturer, penetration rates are still fairly low in the Northwest. However, the regional EnergySmart Grocer program introduced in mid-2007 is likely to continue gaining momentum in impacting penetration rates. Potential obstacles include:

- **Disabled Equipment.** A 2003 survey of vending machines that had VendingMisers installed (in the Energy Trust of Oregon service territory) found that about half of the VendingMisers were not operational because they were unplugged, disabled, or missing. The persistence of savings from CoolerMiser can be expected to exceed that of VendingMiser due to beverage coolers being in locations less prone to vandalism; however this also illustrates a benefit of internal installation (CM2iQ). It may be worth a follow-up visit to make sure CoolerMisers are not unplugged or disabled.

- **Moving Coolers.** Although installation can be quick and easy, it does involve gaining access to the rear of the cooler, which may require unloading the beverages to move the cooler away from the wall, something neither the installer nor the store owner may be willing to do. A lesson may be learned from the lead installer of VendingMisers, who uses Airsleds to easily and safely move full vending machines (even over sticky floors).

- **Advertising Requirements.** Some beverage companies providing coolers to retailers may have concerns about controls that turn off the lighted advertising on their coolers during low occupancy (as CoolerMiser does) because from a distance the coolers may appear to be turned off.

- **Lack of Awareness.** Retailers may be unaware of potential energy savings and uninterested in any measures that may impact sales or disrupt their operation.

Conclusion

As a new application of the technology used in VendingMiser (a product with well documented savings), chances are good that CoolerMiser and CM2iQ will be effective products. In addition to being ubiquitous, coolers are expensive and have long lives, so are replaced infrequently and therefore may be good candidates for retrofit. It's important for retailers to understand that if they have CoolerMiser or CM2iQ installed, the cooler should not contain any perishable food. In addition, if a CoolerMiser is installed, nothing should be stored on top of the cooler.

Regarding energy savings, test results and case studies show a wide range from about $33/year to $170/year, varying with cooler size, utility rate, and occupancy pattern as well as climate and HVAC equipment efficiency. Hopefully these savings are adequate to compensate the retailer for any minor inconvenience of having it installed. Similarly, equipment maintenance and repair savings should help overcome any reservations the beverage suppliers may have.

Market penetration rates for CoolerMiser in the region are low but improving partly due to the regional EnergySmart Grocer program. Customers who respond to the no-cost installation offered by this program may then gain interest in learning about other energy saving opportunities from this and other programs.

The potential impact is substantial, so the potential obstacles noted above should be explored and addressed. Additionally, testing of product performance, estimates of non-energy benefits, and a field survey of persistence of savings after installation should be conducted by an independent organization.

Additional Information

Northwest businesses and electric utilities can contact the *Energy*Ideas Clearinghouse for additional information on this or other energy technologies or products. Contact:

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Note: Product & Technology Reviews are peer reviewed by objective industry professionals prior to publishing.

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