Emerging Technologies (ET) Energy-Efficient Commercial Foodservice—Scaled Field Placement

Food Service Technology—Efficient Ice Machines and Load Shifting

ET Project Number: ET12PGE3151

Project Manager: Charlene Spoor
Pacific Gas and Electric Company

Prepared By: Todd Bell Adam Cornelius Angelo Karas
Contributors: Don Fisher Janel Rupp
Fisher-Nickel, inc.
12949 Alcosta Blvd., Suite 101
San Ramon, CA 94583

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Pacific Gas and Electric Company®

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ABBREVIATIONS AND ACRONYMS

AHRI	Air-Conditioning, Heating, and Refrigeration Institute
CEE	Consortium for Energy Efficiency
CT	Current Transformer
DR	Demand Response
FSTC	Food Service Technology Center
IMH-A	Ice-Making Head—Air-cooled
PG&E	Pacific Gas & Electric
PLS	Permanent Load Shifting
RCU-A	Remote Condensing Unit—Air-cooled
SC-A	Self-Contained—Air-cooled
TOU	Time Of Use

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EXECUTIVE SUMMARY

PROJECT GOAL

The goal of this initiative was to demonstrate and quantify the energy-efficiency benefit and load-shifting potential of ice machines, which could be used as a catalyst for the California electric utilities to develop a financial incentive that will accelerate market adoption in a very sizable appliance sector. The FSTC estimates an installed base in California of 300,000 machines (not counting bulk ice production). An estimated 10,000 cube-making machines are sold annually in the state of California alone.

Key to the vision for load shifting ice machines is the fact that the energy consumption rate decreases for the larger machines—especially at the low end of the production capacity (ice harvest rate) range. Representative of this characteristic is the fact that under-counter machines (e.g., 200 lb/24 hr capacity) can use twice the energy of a free-standing ice machine (e.g., 400 lb/24 hr capacity). Also key to the campaign for reduced energy use by this equipment type is the fact that the energy-efficiency has increased, across the board, since ENERGY STAR® was introduced for this category of equipment. A historical review of AHRI data for nominally 400 lb/24 hr capacity ice machines confirmed that the average energy consumption decreased very little, only 2%, from 1994 to 2005 (pre-ENERGY STAR & utility incentives) but by 14% from 2005 to 2012 (with ENERGY STAR & incentives).

PROJECT DESCRIPTION

This demonstration project entailed the replacement of relatively low-efficiency ice machines in four facilities with energy-efficient models while load shifting the ice machine operation exclusively to non–peak utility periods. The energy use and the load profile of each machine were data-logged for at least two weeks and then analyzed to determine appropriate replacement machine capacity and to calculate projected energy and cost savings. In addition, the project called for dissemination of ice machine energy-efficiency knowledge and educational and promotional material through foodservice industry outreach events. Also, the FSTC hosted a focus group meeting amongst utility, manufacturer, end-user, and installer/maintenance personnel to present the results of this field study and outline a program for effective market transformation, with a goal to solicit buy-in and future participation from the ice machine industry.

PROJECT FINDINGS/RESULTS

Projected annual energy reduction for the demonstration sites was in the range of 30%. Furthermore, there was a successful six-hour coincident peak demand reduction at each site, which ranged from 0.52 kW for the smallest capacity machine to 2.0 kW for the largest capacity machine evaluated in this field study. The calculated annual electricity cost saving based on the applicable rate for each facility ranged from $271 to $665 and was in the order of a 40% reduction. There was very favorable feedback from the facility operators regarding improved performance and energy-efficiency.

TABLE ES-1. RESULTS SUMMARY—BRIDGES

	PREEXISTING MACHINE	REPLACEMENT MACHINE
AHRI Ice Harvest Rate (lb/24 hr)	772	1,180
AHRI Energy Consumption Rate (kWh/100 lb)	6.4	4.62
Bin Capacity (lb)	550	710
Normalized Ice Use (lb/d)	600	600
Normalized Duty Cycle (%)	81.5%	51.9%
Normalized Operating Time (hr/d)	19.6	12.5
Ice Machine Power (kW)	2.0	2.2
Normalized Annual Energy Use (kWh/yr)	14,310	10,040
Annual Energy Reduction (kWh/yr)	4,270	
Percent Energy Reduction (%)	29.8%	
Six-Hour Average Coincident Peak Reduction (kW)	2.0	
Annual Energy Charges	$1,701	$1,153
Annual Demand Charges	$156	$39
Total Annual Electricity Cost	$1,857	$1,192
Net Annual Electricity Cost Reduction	$665	
Net Annual Electricity Cost Reduction (%)	36%	

TABLE ES-2. RESULTS SUMMARY—TRUEBURGER

	PREEXISTING MACHINE	REPLACEMENT MACHINE
AHRI Ice Harvest Rate (lb/24 hr)	147	410
AHRI Energy Consumption Rate (kWh/100 lb)	10.27	5.73
Bin Capacity (lb)	80	290
Normalized Ice Use (lb/d)	120	120
Normalized Duty Cycle (%)	88.7%	29.4%
Normalized Operating Time (hr/d)	21.3	7.0
Ice Machine Power (kW)	0.521	0.975
Normalized Annual Energy Use (kWh/yr)	4,050	2,530
Annual Energy Reduction (kWh/yr)	1,520	
Percent Energy Reduction (%)	29.8	
Six-Hour Average Coincident Peak Reduction (kW)	0.521	
Annual Energy Charges	$704	$433
Annual Demand Charges	N/A	N/A
Total Annual Electricity Cost	$704	$433
Net Annual Electricity Cost Reduction	$271	
Net Annual Electricity Cost Reduction (%)	38.5	

TABLE ES-1. ESTIMATED RESULTS SUMMARY—MAXXI'S

	PREEXISTING MACHINE	REPLACEMENT MACHINE
AHRI Ice Harvest Rate (lb/24 hr)	365	530
Energy Consumption Rate (kWh/100 lb)	7.62	5.54
Bin Capacity (lb)	310	430
Normalized Ice Use (lb/d)	300	300
Normalized Duty Cycle (%)	82.2%	56.6%
Normalized Operating Time (hr/d)	19.7	13.6
Ice Machine Power (kW)	1.17	1.22
Normalized Annual Energy Use (kWh/yr)	8,410	6,070
Annual Energy Reduction (kWh/yr)	2,340	
Percent Energy Reduction (%)	27.8%	
Six-Hour Average Coincident Peak Reduction (kW)	1.17	
Annual Energy Charges	$1,479	$859
Annual Demand Charges	N/A	N/A
Total Annual Electricity Cost	$1,479	$859
Net Annual Electricity Cost Reduction	$620	
Net Annual Electricity Cost Reduction (%)	41.9%	

TABLE ES-2. ESTIMATED RESULTS SUMMARY—OAKLAND MUSEUM CAFETERIA

	PREEXISTING MACHINE	REPLACEMENT MACHINE
AHRI Ice Harvest Rate (lb/24 hr)	220	555
Energy Consumption Rate (kWh/100 lb)	8.53	5.29
Bin Capacity (lb)	210	430
Normalized Ice Use (lb/d)	180	180
Normalized Duty Cycle (%)	66.7%	32.4%
Normalized Operating Time (hr/d)	16.0	7.8
Ice Machine Power (kW)	0.917	1.22
Normalized Annual Energy Use (kWh/yr)	5,360	3,480
Annual Energy Reduction (kWh/yr)	1,880	
Percent Energy Reduction (%)	35.1%	
Six-Hour Average Coincident Peak Reduction (kW)	0.917	
Annual Energy Charges	$1,099	$553
Annual Demand Charges	N/A	N/A
Total Annual Electricity Cost	$1,099	$553
Total Annual Electricity Cost	$546	
Net Annual Electricity Cost Reduction	49.7%	
Net Annual Electricity Cost Reduction (%)	$1,099	

PROJECT RECOMMENDATIONS

Combining Operators must be trained to properly use integrated timer technology to fine-tune ice production schedules. Operators should also pull ice early in the morning to ensure that ice is harvested and refilling the bin until noon when the machine is switched off.

The campaign for ice machine load shifting will be accelerated by a targeted incentive program by the California electric utilities. Although the economics of upsizing and load shifting confirmed in this study will inherently drive customers towards this goal, the educational component and financial stimulus of an incentive program will be critical to rapid market adoption.

INTRODUCTION

Ice machines are installed throughout the foodservice and hospitality industry, from bars, delis and restaurants, to hotels, casinos, and other institutional kitchens. Nearly every foodservice operation has at least one ice machine. They also are found in other commercial building types such as offices, laboratories, nursing homes and hospitals. Even supermarkets, with their large refrigeration plants, utilize separate ice machines to supply ice for their meat and seafood displays. Ranging from cube-type, to nugget- and flake-type machines, together this installed base represents one of the largest inventories of foodservice equipment.

The study of ice machines have become one of the more concentrated efforts by the PG&E Food Service Technology Center (FSTC), based on the potential for energy efficiency and non–peak utility period operation. In 2007 the FSTC conducted its first ice machine field study, which characterized the water and energy use of eight individual ice-cube machines in commercial foodservice operations and documented the estimated water and energy saving potential that would be realized by replacing a given unit with a more water/energy-efficient model [1]. In addition, the measured duty cycles combined with the actual electric load profiles reflected the ice utilization patterns and provided insight into the potential for peak load shifting of each machine. In continuation of the first study, a second field investigation was conducted in 2011 [2]. The project centered on the replacement of an older ice machine with a newer, ENERGY STAR® qualified ice machine with a slightly larger production capacity and bin size. The goal was to quantify the resulting energy, water and associated utility cost savings—as well as the additional electricity cost saving by load-shifting ice production exclusively to non–peak periods. Following encouraging results of both studies and eagerness to promote market penetration of high-efficiency equipment, this targeted field-placement project was set forth to further demonstrate and highlight energy-efficient replacement machines in concert with permanent load shifting (PLS).

BACKGROUND

ENERGY EFFICIENCY IMPROVEMENTS

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) provides a Directory of Certified Automatic Commercial Ice Machines and Ice Storage Bins containing ice harvest rate (i.e., production capacity), energy consumption rate, and water use rate data for current models that can be utilized by specifiers and end-users to select energy- and water-efficient models [3]. It can also be used utilities as a basis for financial incentives to promote equipment that is more efficient. Specific energy consumption thresholds are listed in the ENERGY STAR® Program Requirements Product Specification for Automatic Commercial Ice Makers [4] and also in The Consortium for Energy Efficiency (CEE) High Efficiency Specifications for Commercial Ice Makers (CEE Tier 1 and Tier 2 criteria are used for the California Joint Utility Partners current rebate program) [5]. While technological advancements have steadily facilitated lower energy and water consumption rates, in recent years the introduction of the ENERGY STAR classification for ice machines (January 1, 2008) has provided the industry a catalyst for even greater progress.

Upon inspection of the listings, it becomes evident that higher capacity ice machines are inherently more energy-efficient than lower capacity units. When considering only capacity, a general sizing guideline has been to choose a unit that would operate with an average duty cycle of approximately 75% based on the ice harvest rate and the assumed daily ice requirement, which balances machine size and cost with the reserve capacity needed for high ice-demand days, but when energy consumption is also taken into consideration, a higher capacity model with higher efficiency can yield considerable energy saving.

The Department of Energy published two studies that focused on the energy saving potential and R&D opportunities for Commercial Refrigeration. One was published in 1996 and conducted by Arthur D. Little, Inc. [6], and the other was published in 2009 and conducted by Navigant Consulting, Inc. [7]. Both reports described the different types of ice makers and provided insight into design strategies and technologies that could be applied to increase efficiency. Both recognize the fundamental fact that larger machines consume less energy on a per-unit-ice basis than smaller machines. It is interesting to note that neither study suggested that the replacement of an older ice machine with a new machine of a larger capacity was an energy efficiency strategy to consider. Nor was there any reference by the two studies for the potential to shift the operation of an ice machine to non–peak periods.

Figure 1 is a plot as reported in the first DOE study using 1994 ARI (predating AHRI) ice-cube machine data, and Figure 2 is a plot represents 2005 ARI data as a comparison to the 1994 plot. Firstly, both plots illustrate the energy use vs. ice-harvest-rate performance relationship, and secondly, both denote the visually intersected, average energy consumption rate for a 400 lb/24 hr capacity ice machine—one of the most popular sizes. The drop from 7.75 down to 7.5 was only a 2% difference (likely within the margin of error). Moving on to Figure 3 representing 2012 data, compared to the 2005 value of 7.5, the drop down to 6.1 is a 19% decrease in energy use. This marked historical difference reflects the value that ENERGY STAR has created and the importance of utility-sponsored incentive programs to stimulate early retirement of older ice machines.

Furthermore, within the 2012 graph, if the machine selection process is optimized to the best-in-class with some upsizing to the 500-600 lb/24 hr range, the 2012 data reflects an additional 18% reduction in energy use over the average 400 lb/24 hr capacity machine.

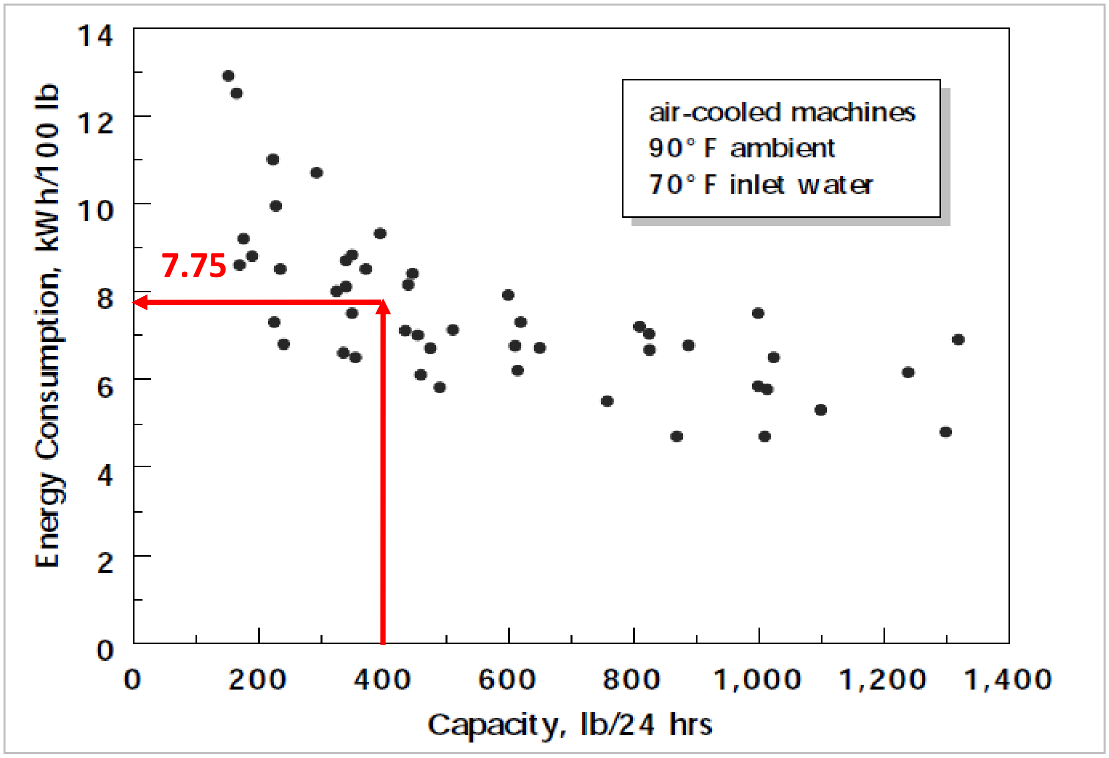


FIGURE 1. 1994 ARI DATA—ENERGY CONSUMPTION VS CAPACITY—REFERENCE DOE

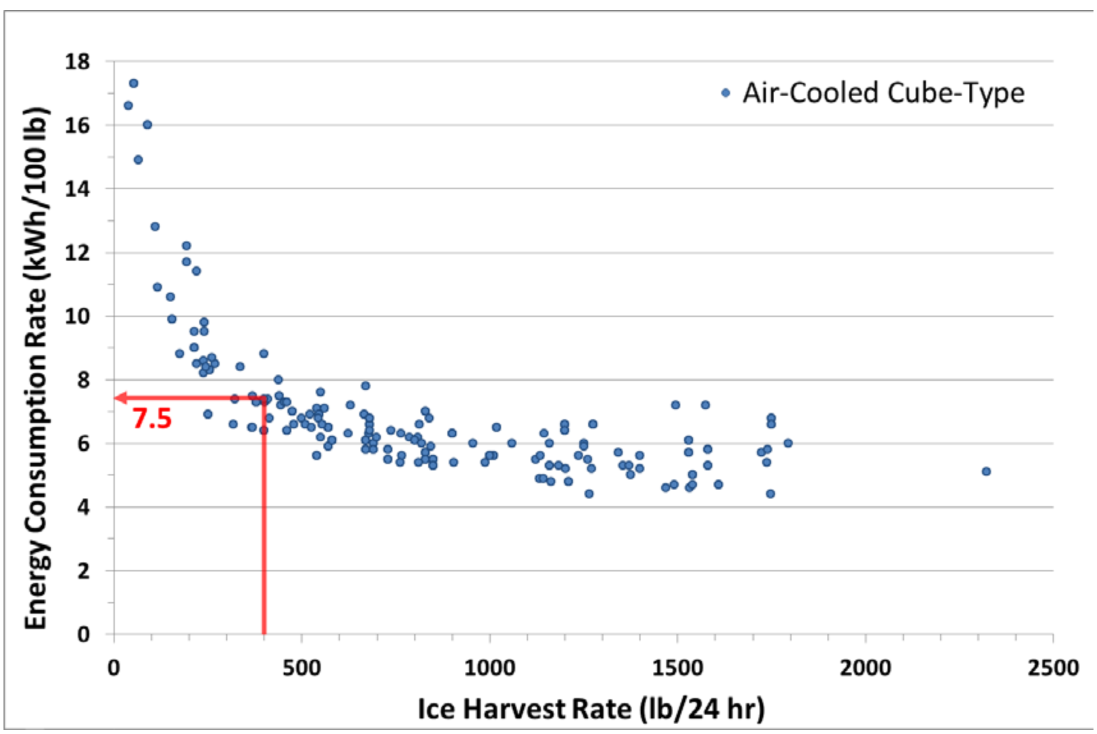


FIGURE 2. 2005 ARI DATA—ENERGY CONSUMPTION RATE VS ICE HARVEST RATE

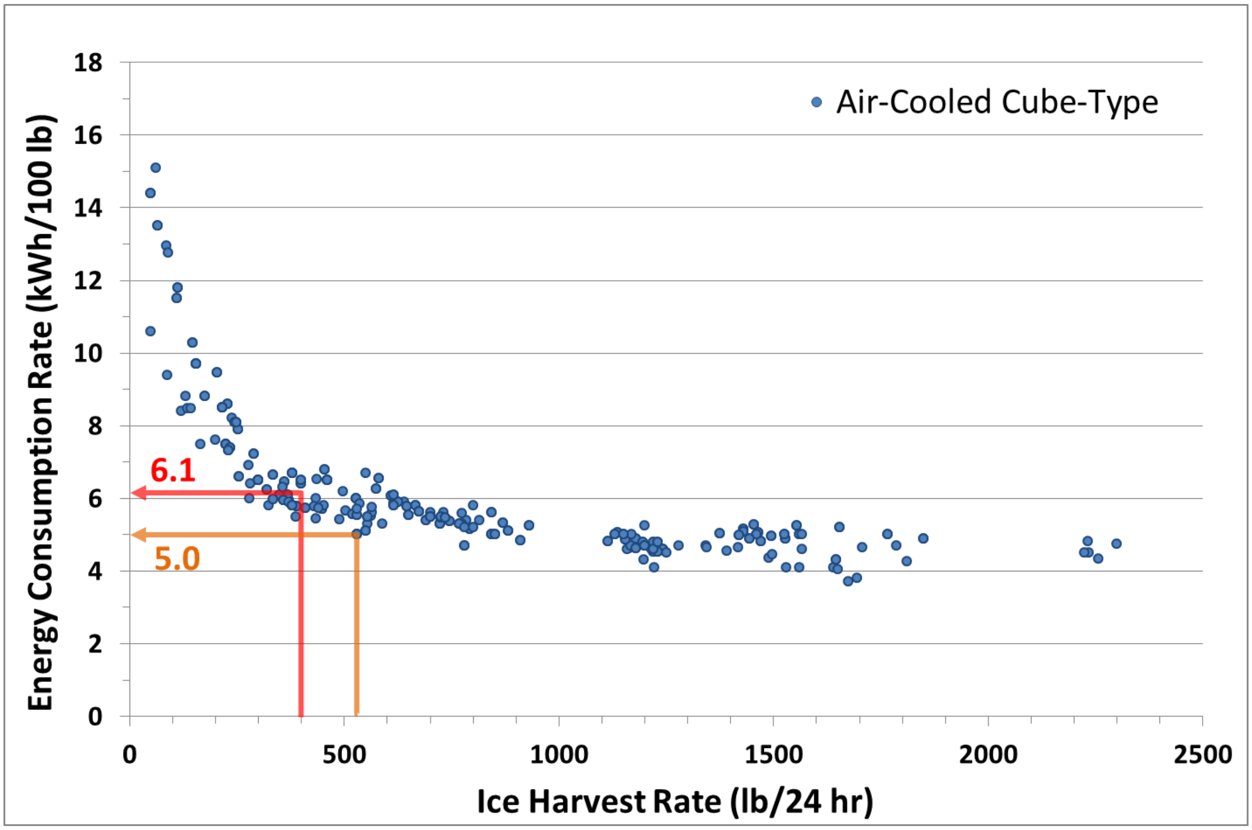


FIGURE 3. 2012 AHRI DATA—ENERGY CONSUMPTION RATE VS ICE HARVEST RATE

NATIONAL ICE MACHINE INVENTORY AND ENERGY LOAD ESTIMATE

The 1996 DOE study estimated the 1993 installed base of ice machines to be 1.2 million units, with new shipments in 1993 totaling 188,000 units. The 2009 DOE study reported a 2008 inventory of 1.5 million with new shipments in 2003 totaling 197,000 units. The North American Association of Food Equipment Manufacturers (NAFEM) reported sales in 2008 of 216,000 units [8]. Assuming a 7 to 10 year life (also referenced by both DOE studies), the replacement unit sales alone would suggest that the inventory in 2012 is well in excess of 2 million.

From another approximation perspective, the FSTC inventoried 93,000 commercial and institutional foodservice facilities in California in 2010 [8]. With California representing approximately 10% of the U.S. market, the nominal number of foodservice facilities is in the order of one million. Recognizing that many foodservice operations have more than one ice machine, the total inventory of ice machines in foodservice facilities should exceed one million units by a good margin. An unpublished inventory of ice machines compiled by the FSTC as an adjunct to the referenced PIER study estimated 155,000 ice machines in California foodservice operations. Adding in the other commercial and institutional sectors that utilize ice machines, it is plausible that the total ice machine inventory in the U.S. is in the range of 2.5-3 million. For the purpose of this paper and high-level energy load projection, the authors have assumed an installed base of 2.5 million ice machines in the U.S. and 300,000 ice machines in California.

The first DOE study projected the electricity used by the 1.2 million ice machines at 9.4 TWh/yr. The second DOE study estimated that electricity consumption of the 1.5 million units to be 8.1 TWh/yr. The second study reported an energy use of 5,429 kWh/yr per unit to calculate the nationwide use. Prorating the second DOE study estimate of 8.1 TWh/yr for an inventory of 2.5 million units, the annual electricity consumed by ice machines in the U.S. is estimated to be in the order of 13.5 TWh/year.

With average power consumption in the range of 1000 watts per 500 lb ice machine capacity, the authors estimate the peak demand of 2.5 million units to be in the order of 2,500 MW. The associated reduction in electricity generation by shifting the operation of ice machines to non–peak periods would be very significant.

OBJECTIVES

The foundation of this ET project was to select four foodservice facilities to participate in an ice machine assessment and demonstration study, ideally choosing sites using inefficient equipment and/or needing more ice production capacity. The goal was to demonstrate improved energy-efficiency when a) replacing ice machines at selected sites with more energy-efficient models, upsizing the production and bin capacities, and b) provide load-shifting capabilities, either by installing an automatic timer switch, or by selecting an ice machine with an integrated programmable timer.

Outlined below are the project's procedural goals:

- Selecting local sites that would qualify as candidates for the project.
- Monitor the energy use of the preexisting ice machine, noting ice usage and duty cycle.
- Provide replacement machine selection assistance at selected sites, using a mechanical engineer knowledgeable in restaurant design.
- Provide equipment selection as requested, as well as assistance with installing that equipment per code requirements.
- Monitor energy consumption and duty cycle of replacement machine. Quantify ice machine energy-efficiency benefit and load-shifting potential to be used as a catalyst for the California electric utilities to develop a financial incentive that will accelerate market adoption.
- Provide open house/showcase at participating sites. Conduct a FSTC seminar describing all case studies and ice machine knowledge research and to date.
- Hold a focus group meeting for interested manufacturers, suppliers, end-users and service and installation personnel.
- Assemble a one-page success-story case study for each site that can be used for future marketing material. Include the case studies in FSTC outreach programs.
- Provide an ice machine seminar summarizing the results.
- Facilitate a focus group to present the results of this field study and outline a program for effective market transformation, with a goal to solicit endorsement from the ice machine industry.

SCOPE

The project focused exclusively on air-cooled, cube-type machines because they comprise the majority of the installed base and therefore offer the most potential for future energy and peak load shifting. Additionally, water-cooled machines are not applicable to the California Joint Utility Partner rebate program. Facilities with ice machines exhibiting a combination of relatively low production capacity and high ice usage were selected for the study.

Note: Due to report completion time constraints and field site coordination time requirements, two of the four sites have not yet had the replacement machines installed. The machines have been ordered and the final monitoring data will be compiled and included in an addendum to this report in early 2013.

MONITORING AND EVALUATION APPROACH

The four sites selected for this ice machine replacement study were identified in the normal course of FSTC site survey and auditing work after determining the ice machine suitability for replacement and proposing the evaluation plan to the facility owners or operators. The basis for selecting the customer sites for study centered on the general criteria of operator willingness, and the combination of relatively low production capacity and high ice usage. Facilities with large-capacity and relatively efficient machines operating with low duty cycles would have little energy saving potential, although load shifting would could be applicable.

Upon the start of each evaluation, the preexisting ice machine's rated machine production capacity and rated bin capacity were noted. The machine was instrumented and monitored to determine baseline energy consumption, demand and duty cycle. Based on the site assessment and at least two weeks of baseline data, it was determined whether the ice machine was suitable for replacement.

Working with the ice machine suppliers, the FSTC provided guidance on replacement machine specifying, selection and installation. The specification sheets for each replacement machine are shown in Appendix 1. Each of the new machines was equipped with an integrated programmable controller that included a timer function, which was set to shut the machine off through the duration of the utility peak period (noon to 6:00 pm). Upon installation, monitoring was repeated for the new machines. Adequate daily ice production as well as ice accessibility (i.e., a comfortably reachable ice height in the bin) was verified by the kitchen staff and confirmed through the duty cycle data results.

INSTRUMENTATION

Electrical metering used for the Bridges site was a DENT Instruments ElitePro power logger configured to record average power at 30-second intervals. The rated accuracy is better than 1% of reading (<0.5% typical). For the other three sites, Continental Control Systems, WattNode pulse-output watt-hour transducers were used. The resolution is 0.025 Wh/pulse/CT rated amp and the rated accuracy is ±0.5% of reading. The pulses were counted and logged with an Onset Corporation HOBO UX-90-001M pulse logger. The recording interval was set to 30 seconds.

Accompanying current transformers (CTs) used for the electric metering were Dent Instruments CTHSC series, 20A or 50A (depending on the circuit load) CTs. They have a rated accuracy of <0.5%.

Metering accuracy was verified prior to field deployment with calibrated revenue-grade energy meters used for appliance energy-efficiency compliance testing in the FSTC laboratory.

FIELD ANALYSIS AND RESULTS

For each of the following test sites, included is a brief site description and assessment accompanied by photographs of the ice machines, followed by a data collection and analysis section comprising a data summary table and a typical operating profile for the preexisting and replacement ice machines, then followed by a customer feedback section and finally a recommendations section.

The data summary table outlines the preexisting and replacement ice machines rated performance specifications and bin capacity, normalized duty cycle, normalized energy use, load-shifted demand reduction, and operating cost comparisons. The figures following each summary table illustrate typical (three-consecutive-day) operating profiles for the machines while highlighting the machine state during the utility peak period of 12:00 noon–6:00 PM.

DATA ANALYSIS METHODOLOGY

Calculated ice production capacity (at 100% duty cycle) and energy consumption rate were verified against the AHRI rated specifications and considered acceptable for estimation purposes if each were within 10% of the expected values. The AHRI rating values were used for projections and normalizations. Ice production was normalized to a nominal value approximating the average ice usage throughout the entire monitoring period of both machines combined.

The measured average cycle power was applied to normalized daily average operating time and applied evenly across each day of the week to calculate annual energy use for the applicable rate schedule for the facility rate to calculate energy and demand charges. Input power of the original machine was used to determine cost reduction derived from peak load shifting.

The data from the incomplete sites are estimated based on preliminary ice usage data and actual power of the preexisting machine, and uses the calculated power of the replacement machine multiplied by the duty cycle required to produce an equivalent amount of ice.

BRIDGES RESTAURANT AND BAR (DANVILLE, CA)

SITE DESCRIPTION

Bridges Restaurant and Bar is a 5,000-square-foot, fine dining restaurant located in the East Bay of the San Francisco Bay Area with a 107 seat dining room, 26 seat bar and 48 seat patio. The restaurant has been in operation for approximately 25 years and occupies a building that is several years older and has had prior restaurants as tenants. The restaurant also operates a wine bar and wine retailer, The Vine, which occupies a nearby adjacent building of approximately 1,000 square feet.

A single, modular ice machine provided ice for the restaurant and The Vine. Bridges was selected as a study site after an energy audit conducted by Food Service Technology Center energy analysts, which analyzed each of the facility's energy using systems. Furthermore, following the audit, restaurant management participated in third-party partnership programs for lighting and refrigeration, which upgraded older, inefficient systems at a small capital expense—less than $2,000.

SITE ASSESSMENT

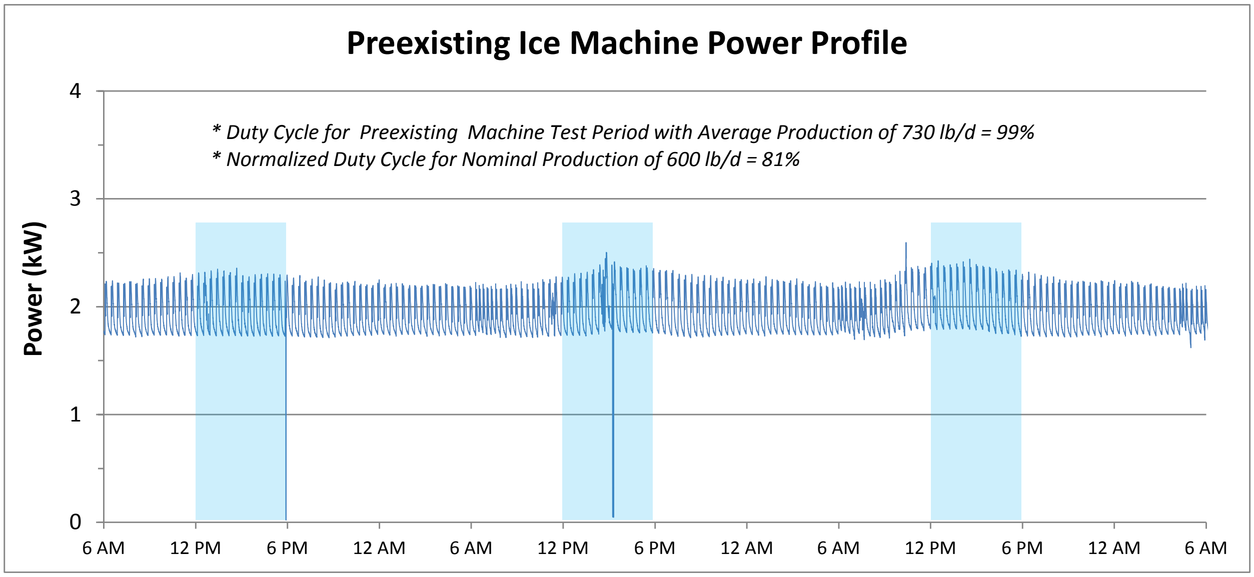
Energy auditors identified the machine as an older, non–Energy Star unit with a nominal 800-pound daily ice-making capacity. Antidotal evidence provided by the operator indicated that the machine struggled to meet ice demands during busy service periods. On the busiest of warm-weather days, the bin was frequently emptied and the operator had to purchase additional ice. Auditors also determined that a new energy-efficient machine with significantly higher ice-making capacity along with a higher capacity storage bin could fit in the same space as the existing unit.

FIGURE 4. BRIDGES PREEXISTING AND REPLACEMENT ICE MACHINES

DATA COLLECTION AND ANALYSIS RESULTS

TABLE 1. BRIDGES RESULTS SUMMARY

	PREEXISTING MACHINE	REPLACEMENT MACHINE
Ice Machine Type	RCU-A	RCU-A
AHRI Ice Harvest Rate (lb/24 hr)	772	1,180
AHRI Energy Consumption Rate (kWh/100 lb)	6.4	4.62
Bin Capacity (lb)	550	710
Normalized Ice Use (lb/d)	600	600
Normalized Duty Cycle (%)	81.5%	51.9%
Normalized Operating Time (hr/d)	19.6	12.5
Ice Machine Power (kW)	2.0	2.2
Normalized Annual Energy Use (kWh/yr)	14,310	10,040
Annual Energy Reduction (kWh/yr)	4,270	
Percent Energy Reduction (%)	29.8%	
Average Coincident Peak Reduction (kW)	2.0	
Peak Reduction Time (h/d)	6	
Annual Energy Charges	$1,701	$1,153
Annual Demand Charges	$156	$39
Total Annual Electricity Cost	$1,857	$1,192
Net Annual Electricity Cost Reduction	$665	
Net Annual Electricity Cost Reduction (%)	36%	



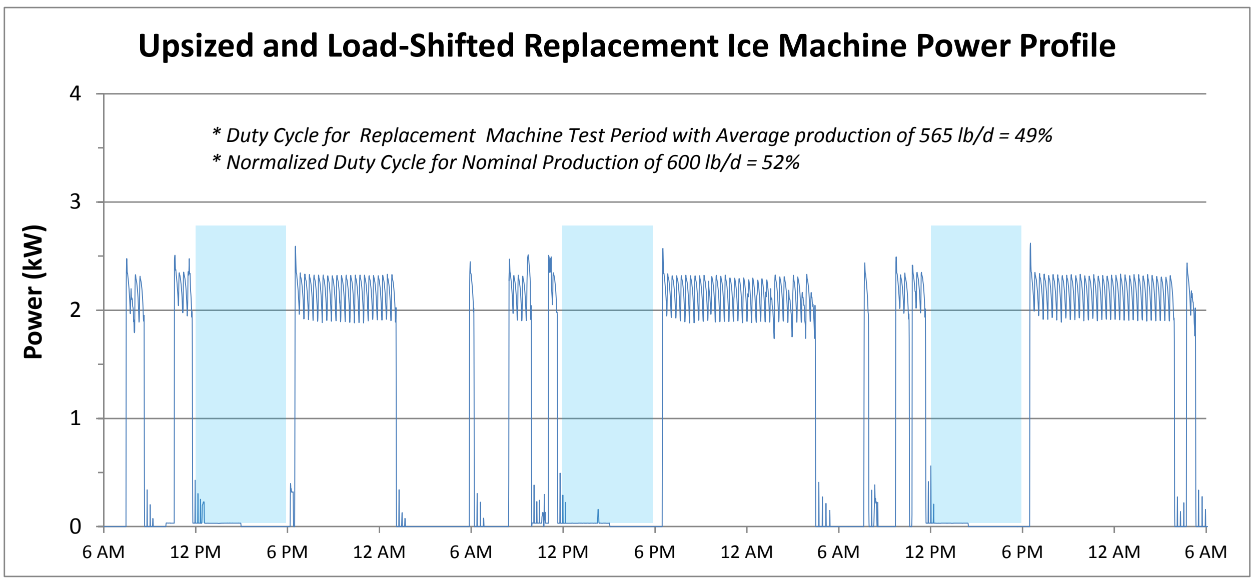


FIGURE 5. BRIDGES PREEXISTING AND REPLACEMENT ICE MACHINE POWER PROFILES

OBSERVATIONS AND RECOMMENDATIONS

Installation of the new ice machine was a success and delivered increased ice-making capacity as well as significant energy savings. Due to its ample ice-making and storage capacity, the unit was turned off for the entire six hours of the peak utility rate period with no adverse effects experienced by the operators.

The single exception to this was on the first day that the load shift time schedule was programmed into the machine—coincidently on a popular street-fair day when the restaurant experienced a peak service volume day where sales exceeded a typical peak day by 15%. (An initial trial was conducted without time-scheduled operation to verify the duty cycle of the new machine was low enough to commit to six hours of load shifting.) Demand for ice was extremely high in the mid to late afternoon hours when the machine was shut off and the ice bin was drawn down to near its bottom. While the operator did not run out of ice, the draw-down was significant enough that he expressed concern that he may have.

As a result of this experience, FSTC researchers and the ice machine distributor returned to the restaurant to explain proper daily ice management and familiarize the staff with the machine's program bypass feature. In this case, proper ice management entails pulling ice from the bin earlier in the morning allowing the machine to harvest more ice and refill the bin before the system shuts off at noon. Furthermore, operators were instructed to "level" the ice in the bin to ensure that the ice isn't piled up near the bin sensor.

The actual installation of the ice machine was an involved process due to the remote condensing unit. Installers must consider the refrigerant line set penetration of the roof, rooftop accessibility, hoisting the condensing unit onto the roof, and electrical service requirements of the new machine.

CUSTOMER FEEDBACK

The operator was very satisfied with the replacement machine as it produces significantly more ice than the original machine. The new machine is able to meet the maximum ice demands of the restaurant itself and that of the adjacent wine bar, The Vine. Prior to the new machine's installation, the operator had to purchase additional ice during busy summertime service periods. Furthermore, the operator noted that the back of house area is much quieter because the new machine's compressor is housed within the remote condensing unit on the roof (as opposed to within the ice-making head as in the original unit).

BRIDGES SHOWCASE (10/23/2012)

The showcase event was held at Bridges on October 23, 2012 between the hours of 1:30 PM and 3:30 PM. The event was promoted through flyer distribution to vendor customers, local FSTC database contacts, restaurant contacts in the Tri-Valley area, and to friends of the restaurant owner. The event was also promoted on FSTC's website (fishnick.com) and Facebook page, as well as through the Golden Gate Restaurant Association (GGRA) newsletter. PG&E sent mailers and e-mails to restaurants in nearby zip codes, and FSTC and PG&E staff canvassed the Danville area on the day of the event.

FIGURE 6 BRIDGES SHOWCASE (10/23/2012)

Twenty-one guests attended the event, as well as 17 representatives from ten vendors, including the East Bay Municipal Utility District, Contra Costa County Green Business program, Contra Costa County Environmental Health, and vendor representatives for energy-efficient lighting and ice-making products.

The event was held on a Tuesday to allow owner/operators the ability to have staff cover for them on a slower day of the week. Most attendees came to the event either at the beginning or towards the end of the showcase. Both setup and cleanup had to be quick to avoid interfering with Bridge's normal operations.

The layout for the Bridges showcase included tables for vendors, two digital displays to illustrate Bridges' energy saving story, and one TV display to highlight the rebate story. A storyboard and flyers for the Bridges case study were included, as was the Bridges chef's bio. Flyers for rebates, seminars, FSTC contacts, and estimated ROI as a result of replacing existing equipment were also included, as were seminar calendars and lists of qualifying foodservice equipment. A Manitowoc ice machine with the integrated timer was on display at the event.

A list of attendees for the Bridges showcase event can be found in Appendix 2, and the Bridges case study can be found in Appendix 4.

Some feedback collected and insight gained from the Bridges showcase included the following:

- The layout at Bridges worked well. Registration was set up outside, and patio doors were used as the main entrance. It was a smaller space, but it made it feel like there was more activity.
- Feedback from attendees indicated that the Bridges display looked nice and was a focal part of the event as people walked in. Vendors were very pleased with the event and felt that it also gave them a better opportunity to understand the programs offered to restaurants through PG&E, and how they could promote these programs to help their customers/clients as well.

The Bridges demonstration project was also a central element of the FSTC booth at the annual US Foods Show in Pleasanton, CA (presented later).

TRUEBURGER (OAKLAND, CA)

SITE DESCRIPTION

True Burger is a 1,000-square-foot, fast-casual restaurant located in the central business district of the City of Oakland, a major metropolitan center of the San Francisco Bay Area. The restaurant is on a busy thoroughfare and has a 40-seat dining room. Much of the restaurant's business is devoted to take-out orders. Ice was provided by a self-contained under-counter ice machine with integrated bin.

A FSTC energy analyst was involved in the build-out of the restaurant and reviewed equipment schedules and mechanical drawings to help the owners mitigate energy use through the specification of energy-efficient appliances and equipment. The under-counter ice machine was selected due to space constraints in the kitchen.

SITE ASSESSMENT

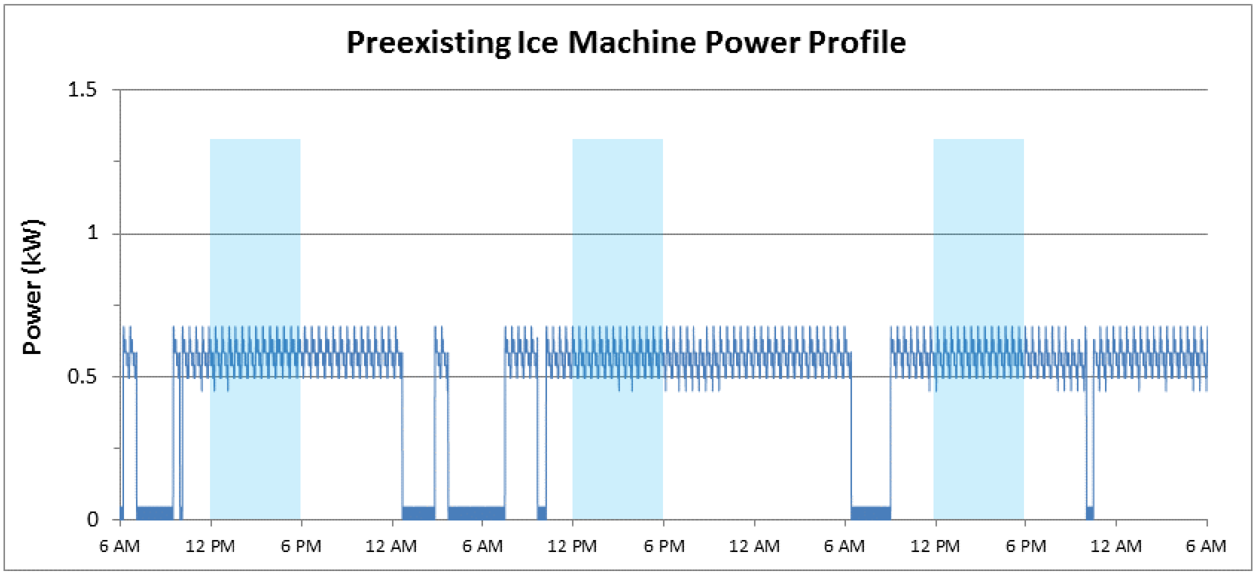
Researchers contacted the operator during the course of the study as they sought to identify sites with an under-counter unit, which if replaced with a larger, energy-efficient model could yield significant energy savings and potential to turn the machine completely off during the peak utility rate period. The preexisting machine was Energy Star qualified but inherently exhibited higher energy usage relative to the ice production. The operator also advised that the existing machine was inadequate for the restaurant ice demands and that ice had to be purchased on busy service days—usually once or twice per week. Installation of the new larger modular unit with an ice-making head and accompanying bin required FSTC researchers and the operator to modify the kitchen space to accommodate the unit. This included removal of an underutilized work surface and replacement of a two-compartment utility sink with a single-compartment sink.

FIGURE 7. TRUEBURGER PREEXISTING AND REPLACEMENT ICE MACHINES

DATA COLLECTION AND ANALYSIS RESULTS

TABLE 2. TRUEBURGER RESULTS SUMMARY

	PREEXISTING MACHINE	REPLACEMENT MACHINE
Ice Machine Type	SC-A	IMH-A
AHRI Ice Harvest Rate (lb/24 hr)	147	410
AHRI Energy Consumption Rate (kWh/100 lb)	10.27	5.73
Bin Capacity (lb)	80	290
Normalized Ice Use (lb/d)	120	120
Normalized Duty Cycle (%)	88.7%	29.4%
Normalized Operating Time (hr/d)	21.3	7.0
Ice Machine Power (kW)	0.521	0.975
Normalized Annual Energy Use (kWh/yr)	4,050	2,530
Annual Energy Reduction (kWh/yr)	1,520	
Percent Energy Reduction (%)	29.8	
Average Coincident Peak Reduction (kW)	0.521	
Peak Reduction Time (h/d)	6	
Annual Energy Charges	$704	$433
Annual Demand Charges	N/A	N/A
Total Annual Electricity Cost	$704	$433
Net Annual Electricity Cost Reduction	$271	
Net Annual Electricity Cost Reduction Percentage	38.5%	



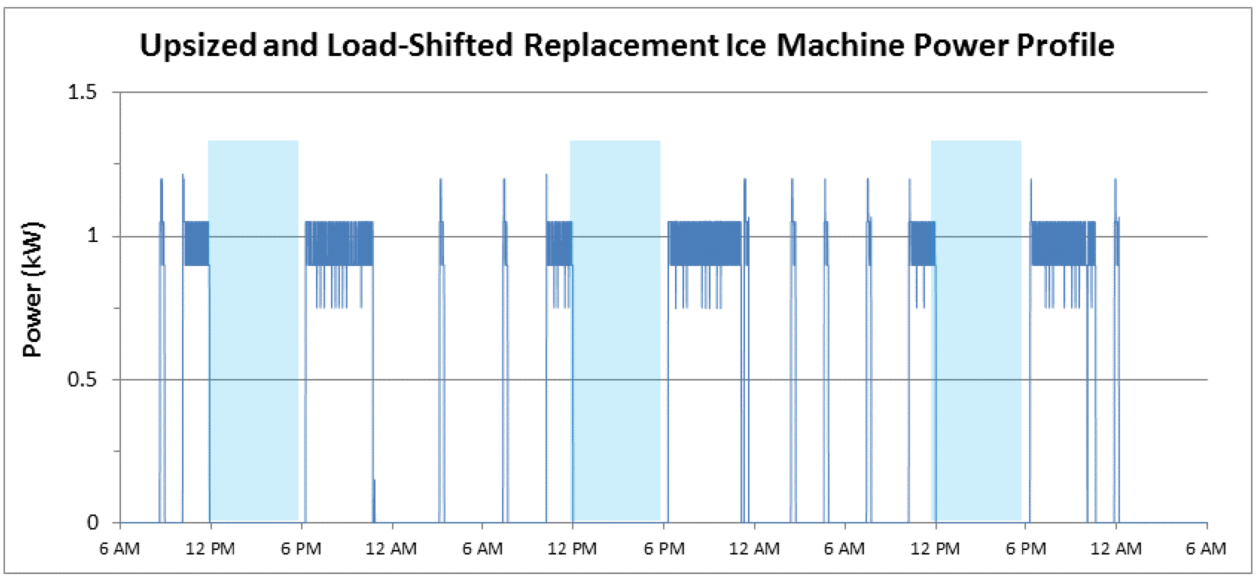


FIGURE 8. TRUEBURGER PREEXISTING AND REPLACEMENT ICE MACHINE POWER PROFILES

OBSERVATIONS AND RECOMMENDATIONS

Installation of the new ice machine was a success and delivered increased ice-making capacity as well as significant energy use reduction. Due to its ample ice-making capacity, the unit was turn off for the entire peak utility rate period with no adverse effects experienced by the operator. Furthermore, the machine has enough capacity to be shut off during part-peak hours during late morning and early evening.

CUSTOMER FEEDBACK

The operator has been extremely pleased with the new machine as it now provides sufficient ice for service periods and does not operate during the busiest part of the day, thus avoiding the added noise and heat in the kitchen.

MEXXI'S (SAN RAMON, CA)

Includes baseline monitoring and estimated results for the planned machine replacement.

SITE DESCRIPTION

Mexxi's Restaurant is a 900-square-foot, casual dining restaurant located in a multi-unit commercial development in the suburban city of San Ramon with a population of 73,000.

A single, modular ice machine provides ice for the restaurant. In addition to the ice used for beverages, ice is also used for cooling in a condiments station. Mexxi's was selected as a study site after an energy audit conducted by Food Service Technology Center energy analysts, which analyzed each of the facility's energy using systems.

SITE ASSESSMENT

The energy auditor identified the existing machine as having a relatively low production capacity and thus a relatively low-efficiency, even though the machine was Energy Star qualified when new. It appeared to be producing excessive heat from the condensing unit, which was an indication of possible mechanical problems. The operator advised that the machine frequently ran out of ice—due in some part to the excess heat around the machine that in turn decreases production capacity. The site presented the opportunity to replace the existing machine with a larger capacity, energy-efficient, remote condensing unit model, which would eliminate the heat load on the interior space and result in a more comfortable work environment.

FIGURE 8. MEXXI'S PREEXISTING ICE MACHINE

DATA COLLECTION AND ANALYSIS RESULTS

TABLE 4. MEXXI'S RESULTS SUMMARY (ESTIMATED)

	PREEXISTING MACHINE	REPLACEMENT MACHINE
Ice Machine Type	IMH-A	RCU-A
AHRI Ice Harvest Rate (lb/24 hr)	365	530
AHRI Energy Consumption Rate (kWh/100 lb)	6.30	5.54
Actual Energy Consumption Rate (kWh/100 lb)	7.62	5.54
Bin Capacity (lb)	310	430
Normalized Ice Use (lb/d)	300	300
Normalized Duty Cycle (%)	82.2%	56.6%
Normalized Operating Time (hr/d)	19.7	13.6
Ice Machine Power (kW)	1.17	1.22
Normalized Annual Energy Use (kWh/yr)	8,410	6,070
Annual Energy Reduction (kWh/yr)	2,340	
Percent Energy Reduction (%)	27.8%	
Average Coincident Peak Reduction (kW)	1.17	
Peak Reduction Time (h/d)	6	
Annual Energy Charges*	$1,479	$859
Annual Demand Charges*	N/A	N/A
Total Annual Electricity Cost	$1,479	$859
Net Annual Electricity Cost Reduction	$620	
Net Annual Electricity Cost Reduction Percentage	41.9%	

**Based on PG&E A-1 TOU rate schedule*

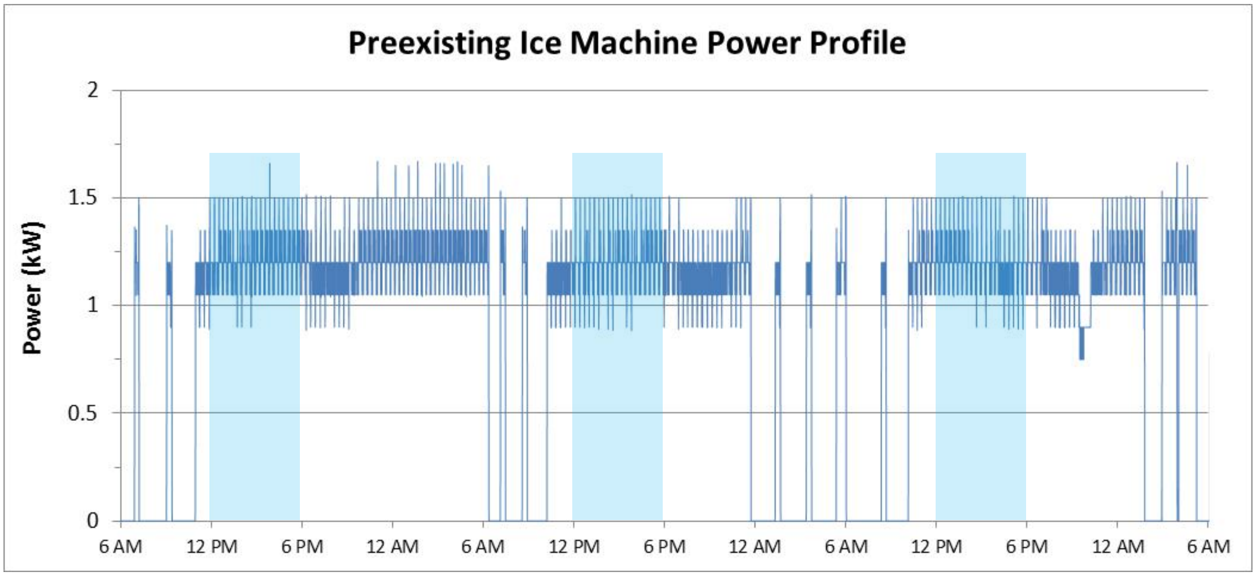


FIGURE 9. MEXXI'S PREEXISTING ICE MACHINE POWER PROFILE

OAKLAND MUSEUM CAFETERIA (OAKLAND, CA)

Includes baseline monitoring and estimated results for the planned machine replacement.

SITE DESCRIPTION AND ASSESSMENT

The cafeteria is a 75 seat dining facility serving museum patrons. The museum is located in the central business district of the City of Oakland, a major metropolitan center of the San Francisco Bay Area. The Oakland Museum was selected as a study site after an energy audit conducted by Food Service Technology Center energy analysts, which analyzed each of the facility's energy-using systems. A single modular ice machine provides ice used for the self-serve soda machine, and occasionally for remote ice tubs holding canned and bottled beverages during special events.

The ice machine was identified as an older (about 10 years old) model with nominal daily ice-making capacity of 300 pounds with a relatively high rated-energy-consumption rate. The preexisting machine had adequate ice-making capacity and storage for the facility's current needs but would be insufficient to make up for the six hours of peak period shut-off time. The replacement machine will have a considerably higher production capacity and a larger storage bin. Ice machine parameters, energy use, demand, and estimated post-replacement savings values are included in the following summary table.

FIGURE 10. OAKLAND MUSEUM CAFETERIA—EXISTING ICE MACHINE

DATA COLLECTION AND ANALYSIS RESULTS

TABLE 11. OAKLAND MUSEUM CAFETERIA RESULTS SUMMARY (ESTIMATED)

	PREEXISTING MACHINE	REPLACEMENT MACHINE
Ice Machine Type	IMH-A	RCU-A
AHRI Ice Harvest Rate (lb/24 hr)	220	555
AHRI Energy Consumption Rate (kWh/100 lb)	7.90	5.29
Actual Energy Consumption Rate (kWh/100 lb)	8.53	5.29
Bin Capacity (lb)	210	430
Normalized Ice Use (lb/d)	180	180
Normalized Duty Cycle (%)	66.7%	32.4%
Normalized Operating Time (hr/d)	16.0	7.8
Ice Machine Power (kW)	0.917	1.22
Normalized Annual Energy Use (kWh/yr)	5,360	3,480
Annual Energy Reduction (kWh/yr)	1,880	
Percent Energy Reduction (%)	35.1%	
Average Coincident Peak Demand Reduction (kW)	0.917	
Peak Demand Reduction Time (hr/d)	6	
Annual Energy Charges*	$1,099	$553
Annual Demand Charges*	N/A	N/A
Total Annual Electricity Cost	$1,099	$553
Net Annual Electricity Cost Reduction	$546	
Net Annual Electricity Cost Reduction Percentage	49.7%	

**Tentatively based on PG&E A-1 TOU rate schedule*

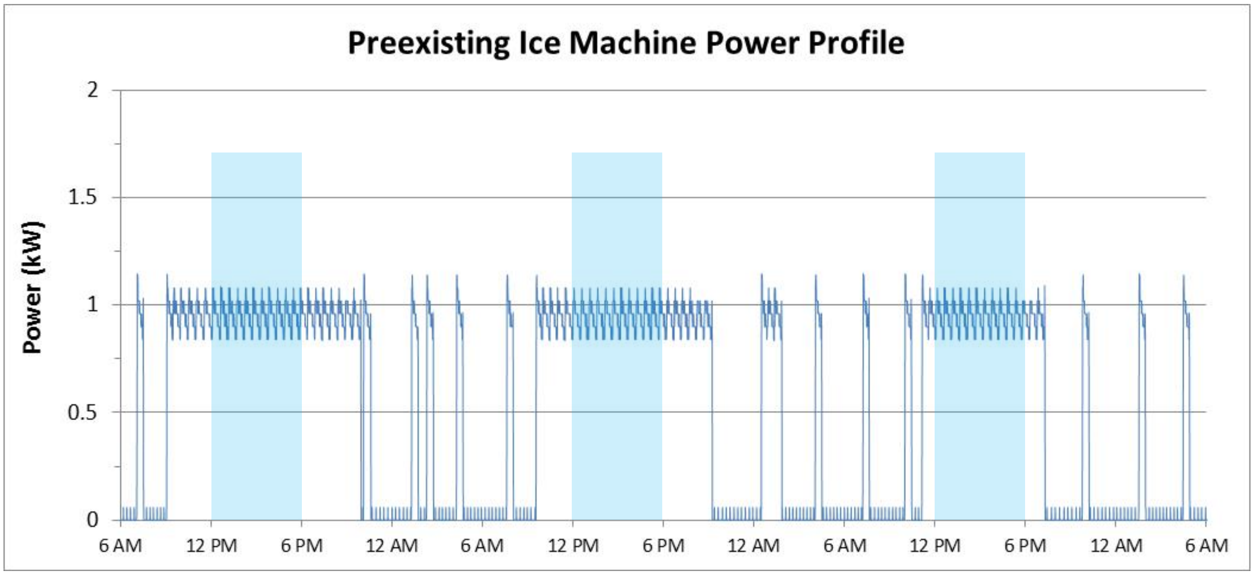


FIGURE 11. OAKLAND MUSEUM CAFETERIA—PREEXISTING ICE MACHINE POWER PROFILE

SHOWCASE AT COMAL RESTAURANT (10/4/2012)

The showcase was held at Comal Restaurant located in Berkeley, CA on October 4, 2012 between the hours of 10:00 AM and noon. The event was promoted through flyer distribution by the City of Berkeley to over 600 restaurants and foodservice establishments, to local FSTC database contacts, to vendor customers, and to friends of the restaurant owner. The event was also promoted on FSTC's website (fishnick.com) and Facebook site, as well as through the newsletters of both the GGRA and the San Ramon Chamber of Commerce. PG&E sent mailers and e-mails to restaurants in nearby zip codes, and PG&E's area representative canvassed the area on the day of the event.

Twenty-nine guests attended the event, as well as 19 representatives from 12 vendor including the East Bay Municipal Utility District, Alameda County Green Business program, and vendor representatives for energy-efficient lighting and ice making products.

The layout for the Comal showcase included 12 tables for the vendors and the FSTC. There were two digital displays to illustrate Comal's energy saving story, a storyboard and flyers for the Comal case study, and screenshots of Comal's PG&E bill during the monitoring period to show how their energy use had been reduced. Flyers for rebates, seminars, FSTC contacts, and estimated ROI as a result of replacing existing equipment were also included, as were seminar calendars and lists of qualifying foodservice equipment.

Comal incorporates three ice makers in their operation: two stacked cube-type machines over a single bin, and a separate flake-type machine. They were determined to have a low enough duty cycle for load shifting.

FIGURE 12. COMAL SHOWCASE (10/4/2012)

SHOWCASE AT US FOODS SHOW (10/16/2012)

The FSTC hosted a 10x10 booth at the US Foods Seminar and show on October 16, 2012. This showcase and seminar presentation promoted the monitoring work from the ice machine project and showcased the latest ice machine technology with a demonstration unit.

US Foods is a leading foodservice distributor in the U.S., with a client base that includes restaurants, healthcare, hospitality facilities, government operations, and educational institutions. Their event is heavily attended by their customers (US Foods busses in their customers from remote locations for this daylong event). While people attend the event to learn about new products, they are also hoping to find answers to questions regarding their appliance needs, food safety, packaging, etc. So rather than trying to get the restaurant operators/owners to carve time out of their day to reach us at the FSTC facility, they came to us more readily at an event they had already planned to attend.

The US Foods Show seminar and showcase event was a huge success. FSTC staff personnel talked to 88 restaurant owners and operators at the showcase, three of whom signed up for an energy audit. Approximately 40 attendees also attended the seminar. Attendees were very receptive to the FSTC's participation in the event, and the movement from digital signs placed at the booth attracted the attention of show attendees to the showcase. 10-15 minutes was spent with about half of them to talk about PG&E programs and the FSTC, and to help answer questions and offer suggestions. The US Foods Show proved to be a venue where the message of energy-efficient appliances can effectively reach the small to medium business (SMB) customer.

FIGURE 13. US FOODS SHOWCASE (10/16/2012)

ICE MACHINE FOCUS GROUP

As an objective of this project, the Food Service Technology Center hosted an industry focus group meeting on November 8, 2012. The goal was to present the results of replacing existing ice machines with upsized, ENERGY STAR qualified ice machines and to engage the industry on a campaign to transform the market in California. Participation at the focus group meeting included representatives from three manufacturers/distributors of ice machines, a local service agency and a major quick service restaurant chain along with representatives from San Diego Gas & Electric (SDG&E), Southern California Edison (SCE) and Pacific Gas & Electric.

The meeting commenced with introductions, followed by a presentation by the FSTC team that summarized our goals and experiences with respect to decreasing the energy use of ice machines in commercial foodservice facilities and the potential for non–peak operation. Throughout the meeting, the participants identified issues that should be considered while providing recommendations that would accelerate market adoption. Following are some of the several ideas, concerns and suggestions that were discussed.

Implementation

- It was anecdotally reported by one of the distributers (at the meeting) that there are 10,000 cube-making machines sold annually in the state.
- It was mentioned by the focus group participants that only 2.5% of equipment sold is not included in this directory (due to some manufacturers not participating in AHRI certification, which is a voluntary process).
- The ability of the customer to override a timer or built-in control is important. It should be possible to automate this aspect by using a timer together with bin-level sensing to override time-of-day controls. PG&E emphasized that an override option needs to automatically reset itself for the programed load shift. PG&E expressed a preference to align with the most energy-efficient equipment; they see timers as a bridge while recognizing the need for continuous commissioning.
- SCE would like to see a pilot project for interconnectivity with ice machines (Zigbee/wireless protocol, bin-level sensing, integrated with ice machine control). Control would be initiated from the utility on a critical peak day. SCE has 40,000 standalone restaurants; 500-1,000 sites with standalone meters (a sufficient sample size). We are trying to encourage manufacturers to build in timers, but it is a cost. The suggestion arose to develop a box that responds to signals such as price signals and is manufacturer-neutral.
- An ice machine distributor asked, "What would make energy companies comfortable that customers have load-shifted?" What if manufacturers could prove it through computerized data logs? PG&E Answer: A smart meter solution may be sufficient—more granular data.
- It will be important to make sure that the technology doesn't leave the area that provided the incentives. This issue was factored into PG&E's point-of-sale pilot for commercial foodservice.
- There was a comment from the service agency with respect to best practice: Level the ice machine bin at end of night—otherwise you limit the capacity of the machine.

- The question was posed: How will information get disseminated to end-users? FSTC responded that site audits include ice machine assessments. The website will also be a primary channel to communicate with the industry.
- One manufacturer representative asked if UL/NSF re-filing would be necessary if a timer was added to the equipment. This concern was extended to whether it would violate the listing or warranty, and whether some customers might believe there isn't enough ice and, and it was just because of the timer. The service agency responded that other equipment has been retrofit without issues with warranty violation (e.g., furnace components).
- One manufacturer representative expressed a concern that if a machine is timed off and an operator runs out of ice, they would typically call service. However, if the service says that machine is not in warranty, and the customer doesn't pay the bill as a result, the service company will go after the manufacturer—not a good public relations scenario.
- PG&E's vision for demand response: Permanent load shift value: 200-600 kW/yr (as an example, PG&E is paying $2,000/kW incentive for ice storage HVAC incentives, and the technology still wasn't cost-effective). Even if a timer is running 95% of the time, it's still more valuable than if you are paying $2,000 kW.
- PG&E mentioned that, for HVAC programs, incentives are passed along upstream to the distributor; it's up to the distributor if they want to share any incentive with the customer. Ice machine incentive programs could be designed the same way.

Replacement Challenges

- Ice machine replacements will be the same as previously—service technicians will have to be educated specifically for new implementations such as integrated programmability or accessory timer switches.
- The utilities need to develop a dealer education *and* service education program.
- Electrical circuit issues: Even though going from a 400-lb/24 hr ice machine to a 600-lb/24 hr ice machine has a $400-$500 incremental cost, above the 600 lb/24 hr is the point where the voltage must increase from 115 V to 208 V. Existing circuit current capacity and replacement machine current requirements and potential upgrade cost must also be considered.
- A question arose on the permitting process: Is a plan check needed to go from 115 V to 208 V? For this reason, it was recommended to use a service channel, rather than the dealer.
- Other upsizing concerns are floor space or footprint limitations, and the potentially excessive added heat load to the space during ice production.
- Installation of remote condensing unit ice machines can be complex and time-consuming and may require permitting. The installation cost can vary widely depending on the building specifics.

Future Focus

- Ice machines represent one of the few pieces of electrical equipment in a restaurant that can be turned off for a period of time within the context of "utility demand response" or "time-of-use" without compromising the foodservice operation. Thanks to the ice storage bin, ice machines have the ability to make ice during periods of the day that are not coincident with the either usage of ice or the utility peak
- There was consensus from the group that our vision for increased energy efficiency and load shifting and/or demand response was achievable on a "reasonable" time frame. The key is to walk before we run and stumble. The discussion focused on deployment strategies versus presenting reasons why the campaign won't succeed.
- The length of time that a given machine can be turned off is a function of its capacity (both ice making and storage) with respect to the demand for ice within the foodservice operation.
- If an existing ice machine has sufficient production and storage capacity to meet the afternoon ice requirement, complete load shift can be achieved.
- If there is not enough capacity for sustained load-shifting over the entire peak period, then some form of automated demand response may be an option for the critical-peak days.
- Retrofitting existing machines with up-sized ENERGY STAR® qualified ice machines provides a tremendous opportunity to combine energy efficiency with "full-time" demand response or permanent load shift (PLS).
- Educational components have to be brought online. It's critical that restaurant operators don't jump on the "load shift" bandwagon and then get burned by running out of ice. It is in the best interest of all to avoid negative experiences and setbacks.
- The utilities need to connect their restaurant customers with service technicians who can integrate and maintain timers.
- Time-of-use rate structure is going to help push this along.
- Follow-up to this focus group meeting: The participants were open to attending a follow-up meeting when the FSTC has completed the next phase of a DR/load-shifting study. An on-going advisory group may evolve as a support to the California utilities.
- In the foreseeable future, it is conceivable that significant portion of the ice making in commercial facilities can be during non–peak periods, and in many cases, during the off-peak hours of the night. This potential can be accelerated if California utilities develop and promote load-shifting or demand response guidelines and programs.

CONCLUSIONS AND RECOMMENDATIONS

As confirmed by this field placement study, ice machines represent one of the few pieces of electrical equipment in a restaurant that can be turned off for a significant period of time without compromising the foodservice operation, e.g., in terms of throughput, temperatures within the space or refrigerated cavity, or lighting levels. Thanks to the ice storage bin, ice machines have the ability to make ice during periods of the day that are not coincident with either the usage of ice or the utility peak period. However, the length of time that a given machine can be turned off is a function of its capacity (both ice making and storage) with respect to the demand for ice within the foodservice facility. This measure of capacity is directly reflected by the duty cycle of the ice machine on a given day and can vary greatly from one ice machine installation to another

If an existing ice machine has sufficient production and storage capacity to meet the afternoon ice requirement, complete load shifting can be achieved. Replacing inefficient machines with upsized ENERGY STAR qualified models provides a tremendous opportunity for combining energy efficiency with permanent load shifting. If there is not enough capacity for sustained load shifting over the entire peak period, then partial-time load shifting or some form of automated demand response may be an option for the critical-peak days.

In the foreseeable future, it is conceivable that all ice making in commercial facilities will be during non–peak periods, and in many cases, during the off-peak hours of the night. This potential can be realized within a relatively short period of time if utilities and energy efficiency organizations develop and promote load-shifting or demand response guidelines and programs. Another unaddressed aspect of load-shifting is the energy reduction due to lower ambient nighttime temperatures. A FSTC cursory data overview suggests that it might an average be in the range of 10% of the total ice machine energy as compared to operating through the afternoon with a 30°F temperature swing typical in areas of California. Further research is required to quantify this energy reduction contribution of lower ambient temperature combined with load-shifted operation.

Utilities and energy efficiency agencies need to work with ice machine manufacturers to determine eligibility of a customer's ice machine for load shifting, or replacement to a larger capacity machine. This will require a low-cost instrumentation package capable of determining the load profile.

The campaign for ice machine load shifting will be accelerated by a targeted incentive program by the California electric utilities. Although the economics of upsizing and load shifting will inherently drive customers towards this goal, the educational component and financial stimulus of an incentive program will be critical to rapid market adoption.

Purchasing a new ice machine with the intention of operating it solely during non–peak requires that it and the storage bin be properly sized to provide sufficient ice reserve during busy hours. It is therefore important to seek advice from the manufacturers, their representatives, or other consultants to determine the appropriate machine/bin size. Whether in new or existing facilities, the potential to combine peak demand reduction with overall energy/water saving through the purchase and installation of a new, high-efficiency ice machine presents an attractive energy-saving opportunity.

APPENDIX 1: APPLIANCE SPECIFICATIONS

BRIDGES REPLACEMENT MACHINE

Manitowoc

QuietQube® i-1470C Remote Ice Cube Machine

Air-Cooled Ice Cube Machine with Patented CVD Technology®

Model

☐ ID-1472C ☐ IY-1474C

ENERGY STAR

ID-1472C Ice Cube Machine - 115V

ICVD Condensing Unit

ID-1472C Ice Machine on a B-970 Bin

Two ID-1472C Ice Machines on a F-1650 Bin

QuietQube Series Remote System consists of a remote condensing unit, interconnecting refrigerant lines, ice machine head section along with an ice storage bin, countertop dispenser, or floor dispenser. All ordered separately. QuietQube ice machine with CVD condensing unit is designed as a Manitowoc system and cannot be used with any other ice machine or remote condenser brand.

- **Space-Saving Design** – Up to to 1,425 lbs. (646 kgs.) daily ice production and only 30" (76.20 cm) wide.
- **Quiet Operation** - eliminates most noise from the refrigeration system. Promotes a relaxing atmosphere.
- **Intelligent Diagnostics** – provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** – for reliable operation in challenging water conditions.
- **EasyRead Display** – communicates operating status, cleaning reminders, and asset information through a blue illuminated display.
- **Programmable Ice Production** – by On/Off Time, Ice Volume or Bin Level (with accessory bin level control) further improves energy efficiency and savings.
- **Easy to Clean Foodzone** – Removable water-trough, distribution tube, splash shield, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **DuraTech™ Exterior** – provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.
- Available **LuminIce™ Growth Inhibitor** controls the growth of bacteria and yeast within the foodzone.

COMMERCIAL WARRANTY

ICE MAKER	EVAPORATOR	COMPRESSOR
3 YEAR PARTS AND LABOR	5 YEAR	5 YEAR PARTS 3 YEAR LABOR

Ice Shape

Half Dice
⅜" x 1⅛" x ⅞"
(.95 x 2.86 x 2.22 cm)

Dice
⅞" x ⅞" x ⅞"
(2.22 x 2.22 x 2.22 cm)

NSF c UL us LISTED CE CALIFORNIA LOW LEAD QUALIFIED AHRI CERTIFIED QUALITY MANAGEMENT SYSTEM CERTIFIED BY DNV ISO 9001:2008

QuietQube® i-1470C Remote Ice Cube Machine

Air-Cooled Ice Cube Machine with Patented CVD Technology®

2110 South 26th Street
PO Box 1720
Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589

www.manitowocice.com

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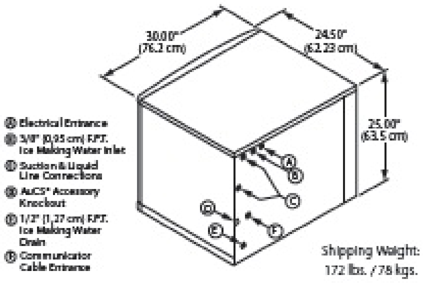
QuietQube® i-1470C Remote Ice Cube Machine

Air-Cooled Ice Cube Machine with Patented CVD Technology®

i-1470C Ice Machine



Specifications

Operating Limits:

- Ambient Temperature Range: 35° to 110°F (1.7° to 43.3°C)
- Water Temperature Range: 35° to 90°F (1.7° to 32.2°C)
- Water Pressure Ice Maker Water In: Min. 20 psi (137.9 kPA) Max. 80 psi (551.1 kPA)

Ice Machine Electric

115/60/1 standard. (230/50/1 also available, consult factory.)

Total Amps: 1.1

Max. fuse size: 15 amps

HACR-type circuit breakers can be used in place of fuses.

Remote Air-cooled Ice Machine

Model	Ice Shape	Ice Production 24 Hours 70°Air/ 50°F Water	Ice Production 24 Hours 90°Air/ 70°F Water*	Power kWh/ 100 lbs @ 90°/70°F*	ENERGY STAR
ID-1472C	dice	1,330 lbs.	1,115 lbs.	4.81	★
		603 kgs.	506 kgs.		
IY-1474C	half-dice	1,425 lbs.	1,180 lbs.	4.62	★
		646 kgs.	535 kgs.		
Water usage/100 lbs./45.4 kgs. of ice					
Potable Water*: 20.1 gallons, 76.1 liters					

AHRI CERTIFIED® *Ratings Certified in Accordance with AHRI Standard 810.

Ice machine for use with ice storage bin or ice dispenser and CVD condensing unit all ordered separately.

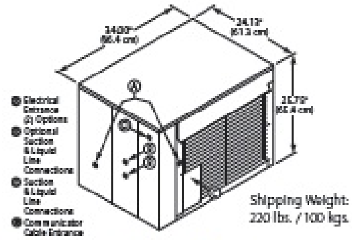
kWh per 100 lbs. is total power of ice machine and condensing unit. Ice machine is 1 ph only. Condensing unit is 1 ph or 3 ph.

Accessories

LuminIce™ Growth Inhibitor reduces yeast and bacteria growth for a cleaner ice machine.

AuCS® Automatic Cleaning System purchased as an option and installed in the field.

iCVD-1495 Remote Condensing Unit



Condensing Unit Electric

208-230/60/1 standard. 208-230/60/3 and 230/50/1 also available. 50 Hz version of this model meets the international standard, IEC60335-1, requirements for "T-tropical rating," the most severe duty rating an ice machine can obtain, (consult factory). HACR-type circuit breakers can be used in place of fuses.

Note: QuietQube ice machine power supply is wired independent of CVD condensing unit.

Min. circuit ampacity 20 *1ph* / 15 *3ph*

Max. fuse size: 20 amps *1ph* / 15 amps *3ph*

HACR-type circuit breakers can be used in place of fuses.

Operating Limits:

- Ambient Temperature Range: -20° to 130°F (-29° to 54°C)

BTU Per Hour: 19,000 (average) 22,000 (peak)

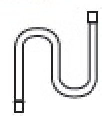
Compressor: Nominal rating: 1.75 HP

Installation Information and Dimensions:

Maximum Line Length
—100' (30.5 m).*

Maximum Vertical Rise*
—35' (10.7 m) above ice machine.

Maximum Vertical Drop
—15' (4.5 m) below ice machine.



**A rise over 20' (6 m) requires S-Trap Kit K-00166 - ordered separately.*

Standard Interconnecting Tubing with Required Communication Wire*

Communication wire comes with each of the following line sets

Model	Line Length ft.	Line Length m.	Weight lbs.	Weight kgs.
RC-25	20	6	14	6
RC-35	30	9	20	9
RC-55	50	15	31	14

**When using a non-Manitowoc line-set, a 18GA 5-conductor communication cable must be installed between the head and condenser sections.*

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Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589
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TRUEBURGER REPLACEMENT MACHINE

Manitowoc

Indigo thinking inside the box

Indigo™ Series 500 Ice Cube Machine

Model: ☐ IR-0500A ☐ ID-0502A ☐ IY-0504A ☐ IR-0501W ☐ ID-0503W ☐ IY-0505W ☐ ID-0592N ☐ IY-0594N

Indigo Series I-500
Ice Machine on B-570 Bin

Designed for operators who know that ice is critical to their business, the Indigo™ Series ice machine's preventative diagnostics continually monitor itself for reliable ice production. Improvements in cleanability and programmability make your ice machine easy to own and less expensive to operate.

- **Space-Saving Design** – Up to 560 lbs. (254 kgs.) daily ice production and only 30" (76.20 cm) wide.
- **Intelligent Diagnostics** – provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** – for reliable operation in challenging water conditions.
- **EasyRead Display** – communicates operating status, cleaning reminders, and asset information through a blue illuminated display.
- **Programmable Ice Production** – by On/Off Time, Ice Volume or Bin Level (with accessory bin level control) further improves energy efficiency and savings.
- **Easy to Clean Foodzone** – Hinged front door swings out for easy access. Removable water-trough, distribution tube, curtain, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **DuraTech™ Exterior** – provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.
- **Available LuminIce™ Growth Inhibitor** controls the growth of bacteria and yeast within the foodzone.

Specifications

BTU Per Hour:

6,100 (average) 6,900 (peak)

Refrigerant:

R-404A CFC-free

Operating Limits:

- Ambient Temperature Range:
  35° to 110°F (1.7° to 43.3°C)
  Water Temperature Range:
  35° to 90°F (1.7° to 32.2°C)
- Water Pressure Ice Maker Water In:
  Min. 20 psi (137.9 kPA)
  Max. 80 psi (551.1 kPA)

Ice Machine Electric

115/60/1 standard.
(208-230/60/1 and 230/50/1 available in Air and Water-Cooled models only)

Minimum circuit ampacity:

Air cooled:	14.2
Water Cooled:	13.5
Remote:	20.0

Maximum fuse size:

Air Cooled:	20.0
Water Cooled:	20.0
Remote:	25.0

Ice Shape

Half Dice 3/8" x 1 1/8" x 7/8" (.95 x 2.86 x 2.22 cm)

Dice 7/8" x 7/8" x 7/8" (2.22 x 2.22 x 2.22 cm)

Regular 1 1/8" x 1 1/8" x 7/8" (2.86 x 2.86 x 2.22 cm)

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Tel: 1.920.682.0161
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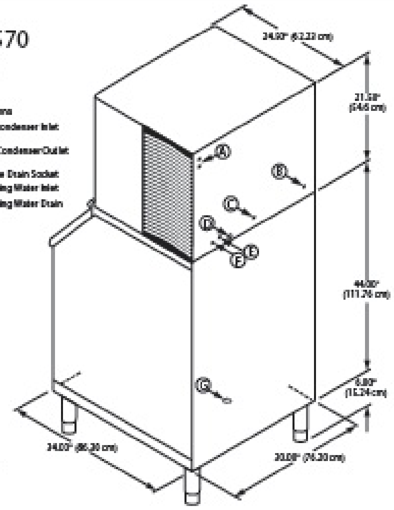
Indigo™ Series 500 Ice Cube Machine

i-500 on B-570 Storage Bin

A Electrical Entrance (2) Options
B 3/8" (0.95 cm) F.P.T. Water Condenser Inlet (water-cooled units)
C 1/2" (1.27 cm) F.P.T. Water Condenser Outlet (water-cooled units)
D 1/2" (1.27 cm) Auxiliary Base Drain Socket
E 3/8" (0.95 cm) F.P.T. Ice Making Water Inlet
F 1/2" (1.27 cm) F.P.T. Ice Making Water Drain
G 3/4" (1.91 cm) Bin Drain



Installation Note
Minimum installation clearance:
Top/sides: 8" (20.32 cm);
Back is 5" (12.7 cm)

Space-Saving Designs

	i-500 B-400	i-500 B-570
Height	59.50" 151.13 cm	71.50" 181.61 cm
Width	30.00" 76.20 cm	30.00" 76.20 cm
Depth	34.00" 86.30 cm	34.00" 86.30 cm
Bin Storage	290 lbs. 131.54 kgs.	430 lbs. 195.04 kgs.

Height includes adjustable bin legs 6.00" to 8.00", (15.24 to 20.32 cm) set at 6.00" (15.24 cm).

Specifications

			Ice Production 24 Hours		Power Usage kWh/100 lbs.@90°Air/70°F	Water Usage/100 lbs. 45.4 kgs. of ice	ENERGY STAR®
	Model	Ice Shape	70°Air/50°F Water	90°Air/70°F Water	1 Ph	Potable Water	
AIR-COOLED	IR-0500A	regular	500 lbs. / 227 kgs.	370 lbs. / 168 kgs.	5.94	19.9 Gal. / 75.3 L	★
	ID-0502A	dice	530 lbs. / 240 kgs.	390 lbs. / 177 kgs.	5.79	19.9 Gal. / 75.3 L	★
	IY-0504A	half-dice	560 lbs. / 254 kgs.	410 lbs. / 186 kgs.	5.73	19.9 Gal. / 75.3 L	★
WATER-COOLED	IR-0501W	regular	500 lbs. / 227 kgs.	420 lbs. / 191 kgs.	4.58	19.9 Gal. / 75.3 L	NA
	ID-0503W	dice	550 lbs. / 249 kgs.	430 lbs. / 195 kgs.	4.58	19.9 Gal. / 75.3 L	NA
	IY-0505W	half-dice	550 lbs. / 249 kgs.	440 lbs. / 200 kgs.	4.52	19.9 Gal. / 75.3 L	NA
	*Water-cooled Condenser Water Usage / 100 lbs. /45.4 kgs. of ice: 165 gal/625 L. * Water-cooled models are excluded from ENERGY STAR qualification.						
REMOTE-COOLED	ID-0592N	dice	480 lbs. / 218 kgs.	430 lbs. / 195 kgs.	5.79	19.9 Gal. / 75.3 L	★
	IY-0594N	half-dice	510 lbs. / 231 kgs.	440 lbs. / 200 kgs.	5.73	19.9 Gal. / 75.3 L	★

Order ice storage bin separately. Ice storage bin and JC-0495 remote condenser must be ordered separately. Consult remote condenser specification sheet for details.

Accessories

LuminIce™ Growth Inhibitor reduces yeast and bacteria growth for a cleaner ice machine.

Bin Level Control Allows ice bin level to be automatically set. Built-in LED light illuminates bin.

Arctic Pure® Water Filters Reduces sediment and chlorine odors for better tasting ice.

AuCS® schedules and performs routine ice machine cleaning automatically.

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Fax: 1.920.683.7589
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MEXXI'S REPLACEMENT MACHINE

Manitowoc

Indigo™ thinking inside the box

QuietQube® i-686C Remote Ice Cube Machine

Air-Cooled Ice Cube Machine with Patented CVD Technology®

Model

☐ ID-0686C ☐ IY-0686C

ENERGY STAR

ID-0686C Ice Cube Machine - 115V

CVD Condensing Unit - 230V

ID-0686C Ice Machine on a B-570 Bin

QuietQube Series Remote System consists of a remote condensing unit, interconnecting refrigerant lines, ice machine head section along with an ice storage bin, countertop dispenser, or floor dispenser. All ordered separately. QuietQube ice machine with CVD condensing unit is designed as a Manitowoc system and cannot be used with any other ice machine or remote condenser brand.

- **New Levels of Performance** – showcasing improved ambient ice production along with reductions in energy consumption: 10% Reduction in energy and 5% improvement in production on a weighted average basis for the i-600 series.
- **ENERGY STAR** - the i-600s exceed ENERGY STAR™ standards and targets future energy efficiency standards.
- **Space-Saving Design** – Up to 634 lbs. (288 kgs) daily ice production and only 30" (76.20 cm) wide.
- **Intelligent Diagnostics** – provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** – for reliable operation in challenging water conditions.
- **EasyRead Display** – communicates operating status, cleaning reminders, and asset information through a blue illuminated display.
- **Programmable Ice Production** – by On/Off Time, Ice Volume or Bin Level (with accessory bin level control) further improves energy efficiency and savings.
- **Easy to Clean Foodzone** – Removable water-trough, distribution tube, splash shield, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **DuraTech™ Exterior** – provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.
- Available **LuminIce™ Growth Inhibitor** controls the growth of bacteria and yeast within the foodzone.

COMMERCIAL WARRANTY

ICE MAKER	EVAPORATOR	COMPRESSOR
3 YEAR	5 YEAR	5 YEAR PARTS
PARTS AND LABOR		3 YEAR LABOR

Ice Shape

Half Dice ⅜" x 1⅛" x ⅞" (.95 x 2.86 x 2.22 cm)

Dice ⅞" x ⅞" x ⅞" (2.22 x 2.22 x 2.22 cm)

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QuietQube® i-686C Remote Ice Cube Machine
Air-Cooled Ice Cube Machine with Patented CVD Technology®

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PO Box 1720
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Fax: 1.920.683.7589

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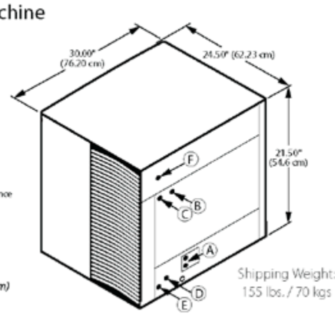
QuietQube® i-686C Remote Ice Cube Machine

Air-Cooled Ice Cube Machine with Patented CVD Technology®

i-686C Ice Machine



Installation Note
Minimum installation clearance:
Top/Sides/Back: 5" (13 cm)

Specifications

Operating Limits:

- Ambient Temperature Range: 35° to 110°F (1.7° to 43.3°C)
- Water Temperature Range: 35° to 90°F (1.7° to 32.2°C)
- Water Pressure Ice Maker Water In: Min. 20 psi (137.9 kPA) Max. 80 psi (551.1 kPA)

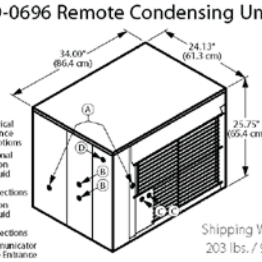
Ice Machine Electric

115/60/1 standard. (230/50/1 also available, consult factory.)
Total Amps: 1.1
Max. fuse size: 15 amps
HACR-type circuit breakers can be used in place of fuses.

iAuCS® Accessory

Schedules and performs routine ice machine cleaning automatically.

iCVD-0696 Remote Condensing Unit



Condensing Unit Electric

208-230/60/1 standard. 208-230/60/3 and 230/50/1 also available. 50 Hz version of this model meets the international standard, IEC335-1, requirements for "tropical rating," the most severe duty rating an ice machine can obtain, (consult factory). HACR-type circuit breakers can be used in place of fuses.
Note: QuietQube ice machine power supply is wired independent of CVD condensing unit.

Min. circuit ampacity:
11.6 *1ph* 10.2 *3ph*

Max. fuse size:
15 amps *1ph* 15 amps *3ph*

HACR-type circuit breakers can be used in place of fuses.

BTU Per Hour:
11,800 (average) 13,700 (peak)

Compressor:
Nominal rating: 1 HP

Operating Limits:

- Ambient Temperature Range: -20° to 130°F (-29° to 54°C)

Remote Air-cooled Ice Machine

Model	Ice Shape	Ice Production 24 Hours: 70°Air/ 50°F Water 21° Air/10°C Water	Ice Production 24 Hours: 90°Air/ 70°F Water 32° Air/21°C Water	Power kWh/ 100 lbs* @ 90°/70°F	ENERGY STAR
ID-0686C	dice	607 lbs.	520 lbs.	5.57	★
		275 kgs	236 kgs		
IY-0686C	half-dice	634 lbs.	530 lbs.	5.54	★
		288 kgs	240 kgs		
Water usage/100 lbs./45.4 kgs of Ice					
Potable Water: 20 gallons, 75.7 liters					

Ice machine for use with ice storage bin or ice dispenser and ICVD condensing unit all ordered separately.

**kWh per 100 lbs. is total power of ice machine and condensing unit. Ice machine is 1 ph only. Condensing unit is 1 ph or 3 ph.*

Installation Information and Dimensions:

Maximum Line Length
—100' (30.5 m).*

Maximum Vertical Rise*
—35' (10.7 m) above ice machine.

Maximum Vertical Drop
—15' (4.5 m) below ice machine.

**A rise over 20' (6 m) requires S-Trap Kit K-00172 - ordered separately.*

Minimum Installation Clearance:
—Top/Sides: 0" (0 cm) Back/Front: 48" (122 cm).

Interconnecting Tubing with Required Communication Wire*

Communication wire comes with each of the following line sets

Model	Line Length ft.	Line Length m	Weight lbs.	Weight kgs
RC-26	20	6	12	5
RC-36	30	9	20	9
RC-56	50	15	28	13

**When using a non-Manitowoc line-set, a 186A 5-conductor communication cable must be installed between the head and condenser sections (K-00435).*

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PO Box 1720
Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589
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OAKLAND MUSEUM CAFETERIA REPLACEMENT MACHINE

Manitowoc

Indigo thinking inside the box

Indigo™ Series 606 Ice Cube Machine

Model: ☐ ID-0606A ☐ IY-0606A ☐ ID-0606W ☐ IY-0606W ☐ ID-0696N ☐ IY-0696N

ENERGY STAR

Indigo Series i-606
Ice Machine on B-570 Bin

Designed for operators who know that ice is critical to their business, the Indigo™ Series ice machine's preventative diagnostics continually monitor itself for reliable ice production. Improvements in cleanability and programmability make your ice machine easy to own and less expensive to operate.

- **New Levels of Performance** – showcasing improved ambient ice production along with reductions in energy consumption: 10% Reduction in energy and 5% improvement in production on a weighted average basis for the i-600 series.
- **ENERGY STAR** – the i-600s exceeds ENERGY STAR℠ standards and targets future energy efficiency standards.
- **Space-Saving Design** – Up to 635 lbs. (288 kgs) daily ice production and only 30" (76.20 cm) wide.
- **Intelligent Diagnostics** – provide 24 hour preventative maintenance and diagnostic feedback for trouble free operation.
- **Acoustical Ice Sensing Probe** – for reliable operation in challenging water conditions.
- **EasyRead Display** – communicates operating status, cleaning reminders, and asset information through a blue illuminated display.
- **Programmable Ice Production** – by On/Off Time, Ice Volume or Bin Level (with accessory bin level control) further improves energy efficiency and savings.
- **Easy to Clean Foodzone** – Hinged front door swings out for easy access. Removable water-trough, distribution tube, curtain, and sensing probes for fast and efficient cleaning. Select components made with AlphaSan® antimicrobial.
- **DuraTech™ Exterior** – provides superior corrosion resistance. Stainless finish with innovative clear-coat resists fingerprints and dirt.
- Available **LuminIce™ Growth Inhibitor** controls the growth of bacteria and yeast within the foodzone.

WARRANTY

ICE MAKER	EVAPORATOR	COMPRESSOR
3 YEAR	5 YEAR	5 YEAR PARTS
PARTS AND LABOR		3 YEAR LABOR

Ice Machine Electric

208-230/60/1 standard.
(230/50/1 also available)

Minimum circuit ampacity:
Air Cooled: 11.1
Water Cooled: 10.7
Remote: 11.7

Maximum fuse size:
Air Cooled: 15
Water Cooled: 15
Remote: 15

Specifications

BTU Per Hour:
11,800 (average)
13,700 (peak)

Refrigerant:
R-404A CFC-free

Operating Limits:

- Ambient Temperature Range: 35° to 110°F (1.7° to 43.3°C)
  Water Temperature Range: 35° to 90°F (1.7° to 32.2°C)
- Water Pressure Ice Maker Water In:
  Min. 20 psi (137.9 kPA)
  Max. 80 psi (551.1 kPA)

Ice Shape

Half Dice
⅜" x 1⅛" x ⅞"
(.95 x 2.86 x 2.22 cm)

Dice
⅞" x ⅞" x ⅞"
(2.22 x 2.22 x 2.22 cm)

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Fax: 1.920.683.7589

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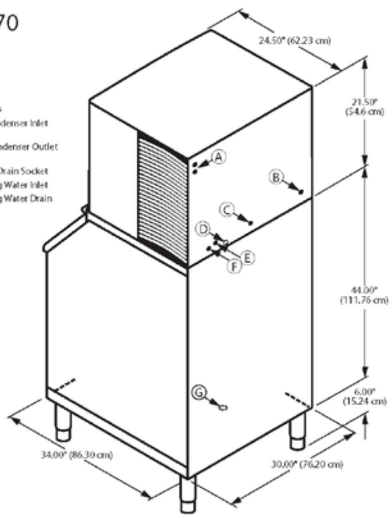
Manitowoc

Indigo™ Series 606 Ice Cube Machine

Manitowoc

Indigo™ Series 606 Ice Cube Machine

i-606 on B-570 Storage Bin



- Ⓐ Electrical Entrance (2) Options
- Ⓑ 3/8" (0.95 cm) F.P.T. Water Condenser Inlet (water-cooled units)
- Ⓒ 1/2" (1.27 cm) F.P.T. Water Condenser Outlet (water-cooled units)
- Ⓓ 1/2" (1.27 cm) Auxiliary Base Drain Socket
- Ⓔ 3/8" (0.95 cm) F.P.T. Ice Making Water Inlet
- Ⓕ 1/2" (1.27 cm) F.P.T. Ice Making Water Drain
- Ⓖ 3/4" (1.91 cm) Bin Drain

Installation Note
Minimum installation clearance:
Top/sides: 8" (20.32 cm); Back is 5" (12.7 cm)

Space-Saving Designs

	i-606 B-400	i-606 B-570
Height	59.50" 151.13 cm	71.50" 181.61 cm
Width	30.00" 76.20 cm	30.00" 76.20 cm
Depth	34.00" 86.30 cm	34.00" 86.30 cm
Bin Storage	290 lbs. 131.7 kgs	430 lbs. 195.2 kgs

Height includes adjustable bin legs 6.00" to 8.00", (15.24 to 20.32 cm) set at 6.00" (15.24 cm).

Kit K00347 ice deflector must be ordered separately if used with: non-Manitowoc bins, Manitowoc F-Style bins and Manitowoc B-750, B-1050, B-1100, and B-1400 bins.

Specifications

	Model	Ice Shape	Ice Production 24 Hours: 70°Air/ 50°F Water 21° Air/10°C Water	Ice Production 24 Hours: 90°Air/ 70°F Water 32° Air/21°C Water	Power Usage kWh/100 lbs. @90°Air/70°F 1 Ph	Potable Water Usage/100 lbs. 45.4 kgs of Ice	ENERGY STAR®
AIR-COOLED	ID-0606A	dice	632 lbs. / 287 kgs	490 lbs. / 222 kgs	5.41	20.0 Gal. / 75.7 L	★
AIR-COOLED	IY-0606A	half-dice	635 lbs. / 288 kgs	555 lbs. / 252 kgs	5.29	20.0 Gal. / 75.7 L	★
WATER-COOLED	ID-0606W	dice	661 lbs. / 300 kgs	575 lbs. / 261 kgs	4.44	20.0 Gal. / 75.7 L	NA
WATER-COOLED	IY-0606W	half-dice	700 lbs. / 318 kgs	580 lbs. / 263 kgs	4.45	20.0 Gal. / 75.7 L	NA
	* Water-cooled Condenser Water Usage / 100 lbs. /45.4 kgs Of Ice: 140 gal./ 530 L. * Water-cooled models are excluded from ENERGY STAR qualification.						
REMOTE-COOLED	ID-0696N	dice	612 lbs. / 278 kgs	535 lbs. / 243 kgs	5.85	20.0 Gal. / 75.70 L	★
REMOTE-COOLED	IY-0696N	half-dice	642 lbs. / 291 kgs	565 lbs. / 256 kgs	5.76	20.0 Gal. / 75.7 L	★

Order ice storage bin separately. Ice storage bin and JC-0895 remote condenser must be ordered separately. Consult remote condenser specification sheet for details.

Accessories

LuminIce™ Growth Inhibitor
reduces yeast and bacteria growth for a cleaner ice machine.

Bin Level Control
Allows ice bin level to be automatically set. Built-in LED light illuminates bin.

Arctic Pure® Water Filters
Reduces sediment and chlorine odors for better tasting ice.

iAuCS®
schedules and performs routine ice machine cleaning automatically.

4770D ©2012 Manitowoc 10/12 Continuing product improvement may necessitate change of specifications without notice.

2110 South 26th Street
PO Box 1720
Manitowoc, WI 54221-1720 USA

Tel: 1.920.682.0161
Fax: 1.920.683.7589
www.manitowocice.com

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APPENDIX 2: SHOWCASE LIST OF ATTENDEES AND VENDORS

BRIDGES LIST OF ATTENDEES

First Name	Last Name	Company / Organization
Pete	Baria	Alameda County Probation
Matthew	Belasco	Pittsburg Unified School District
Waltraud	Charles	Autobahn Cafe
Brian	Chen	Wokkee Chinese Restaurant
Jeffrey	Collins	Antioch Unified School District
Gary	Cooper	Dickeys Barbecue Pit
Javonito	De La Cruz de Morfulleda	OB's Cafe
Maribel	Delgado	Mi Oficina Computer Cafe
Ernie	Guerrero	La Tapatia Mexican Restaurants
Frieda	Hoffman	Local 123
Eric	Janssen	Amber Bistro
Bradly	Kaderabek	Round Hill Country Club
Lawrence	Kong	Minerva's Restaurant
Sherrylyn	Larkins	Jodie's Restaurant
Travis	Law	TriMark Economy Restaurant Fixtures
Eric	Lim	Dragon Terrace
Judy	Macaluso	PG&E
Steven	Myli	East Bay Regional Park District
Sheena	Nagpal	KGSM Inc.
Richard	Nidever	Everex Communications
Aryan	Omar	Aryana Afghan Cuisine
Reyes	Ramos	Agave
Jodie	Royston	Jodie's Restaurant
Michael	Stott	Bear Claw Bakery & Cafe
Martin	Thang	Manns Chinese Cuisine
Quang	Tran	Mrs. FieldsCookies Great Mall
Jeff	Yao	Westin St Francis
Joe	Buhowsky	
Robby	Skog	Maria Maria
Kevin	Michel	ICF/PGE
Bryan	Harder	ICF/PGE
Lee	Huang	Eneron
Tam	Phung	GreenStar Hub
John	Kim	NAMA Restaurant
Jose	Hernandez	Amici's Pizzeria
Payal	Shal	Rising Loafer

Bridges List of Vendors

First Name	Last Name	Company / Organization
Martin	Sum	Contra Costa Environmental Health
Stewart	Bambino	San Ramon Chamber of Commerce
Michael	Panza	Biagio Artisan Meats
Henry	Ichinose	ABS Seafood
Claudia	Pingatore	Green Business Program
Paris	Greenlee	Green Business Program
Stacey	Roth	TriValley CVB
Pete	Palm	Western Pacific Distributors
Charles	Bohlig	EBMUD
Rolando	Gonzalez	EBMUD
Mike	Palm	Western Pacific Distributors
Loretta	Broniak	Energy Retrofit Co.
Deborah	Casagrande	Energy Retrofit Co.

US Foods Show Guests

First Name	Last Name	Company/Organization
Jose	Aguilar	Lone Tree Golf Course
Carol	Aladin	Buckhorn Grill San Francisco
Robin	Aldridge	Kaiser Santa Clara
Tom	Anderson	San Damiano Retreat
Silverio	Arteaga	Buckhorn Grill Napa
Marlen	Benitez	San Damiano Retreat
Gina	Berry	Healdsburg District Hospital
Bob	Boehm	Bobby's Place
Grace	Boehm	Bobby's Place
Pat	Cavanaugh	Carp Harmon
Henry	Chan	The Prolific Oven Bakery
Michael	Clark	Michael's on Main
Robbie	Clearie	Redding Tents & Events Inc.
Dani	Cline	Sabert
Kyle	Coffey	Pacific Connection Catering
Sam	Daniels	American Legion Post 31
Steve	De Parsia	De Parsia's

First Name	Last Name	Company / Organization
Jarrod	DeSoto	Bobby's Place
Robert	Donohoe	St. Mary's Medical Center
Rhiannon	Eddy	The Purple Orchid
Greg	Ellery	Radisson Hotel
Rommel	Esteybar	Pebble Beach Co.
Chris	Faurot	County of Sonoma Probation
Oscar	Flores	Buckhorn Grill San Francisco
Antonio	Gomez	Severinos Sea Cliff Inn
Rod	Goodman	Jenness Park
Shelly	Goodman	Jenness Park Christian Camp
Danny	Guadagnolo	D'bonis Pizza
Chris	Hampton	Handles Gastropub
Marisol	Hernandez	Pacifica Senior Living
Russ	Hollett	Cattlemens
Thomas	Horton	Buckhorn Grill
Brian	Isaeff	US Foods
Chris	Jackson	Jackson Catering & Events
Jose	Jaquez	Faultline Brewing Co
Rocio	Keiser	Buckhorn Grill Embarcadero
Sharbari	Khanna	Kaiser Santa Clara
Jack	Lair	Woody
Karen	Lair	HVFM
Scott	Litteral	Il Forno Classico
Jesse	Lockwood	BW Yosemite Gateway
Debbie	Logan	Kaweah Delta West Campus
Celeste	Lusher	Crusco's Ristorante
Lorelie	Magalong	Veterans Home of CA
Eleni	Magoulas	Pete's Henny Pennys
Nikos	Maheras	Mezes
David	Maria	Buckhorn Grill
Corina	Matsuo	Five Ten Bistro
Rpbert	Matsuo	Bistro Bar Inc.
Ben	Mattman	JW Marriot San Francisco
Matthew	McKnight	The National Hotel
Tom	McLaughlin	Buckhorn Grill
Ian	Melnilsak	Danny's Roadside Kitchen
Steven	Miller	Buckhorn Grill Pleasanton
Aulely	Miranda	Barones Restaurant
Carlos	Orozco	Casa Orozco

First Name	Last Name	Company / Organization
Jesus	Orozco	Casa Orozco
Todd	Parent	Extreme Pizza
Randy	Peters	Randy Peters Catering
Lisa	Peters	Randy Peters Catering
Roger	Praph	La Gare
Paul	Punsalang	Buckhorn Grill Walnut Creek
Mark	Purnell	Afterfive Bar
Juan	R.	500 Club
Stan	Ramirez	Stannie's Place
David	Reich	Outpost
Christine	Reid	Berkeley Bowl Produce, Inc
Thomas	Rimpel	The Westin St. Fracncis
Branden	Rodgers	Jackson Fine Dining
Bill	Rogers	State of CA
Stratis	Rozakeas	Mills-Peninsula Health Services
Juan	Ruiz	Buckhorn Emeryville
Ignacio	Ruiz	Cattlemens
Shaina	Sartor	Nexus
Eric	Schaetz	Chicago Fire
Jefferson	Seay	Chef's Pride
Cynthia	Sidrian	Little Manuel's
Gary	Stidham	Sun City Roseville Community Assoc. Inc.
Nancy	Storm	US Foods
Kathy	Sweet	Pebble Beach Co.
Snehal	Tambe	Plum Tree Care Center
William	Wagner	
Curtis	West	Buckhorn Grill Roseville
Jeff	Yao	The Westin St. Francis
Nazanin	Yasavolian	Amber Systems Technologies

Comal Guests

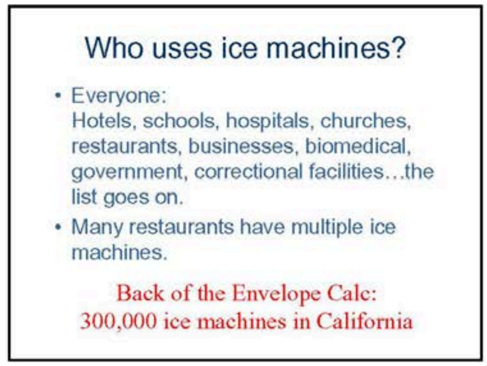
First Name	Last Name	Company/Organization
Araceli	Barriguete	Taqueria Los Cerros
Arlene	Giordano	Le Bateau Ivre
Billi	Romain	City of Berkeley
Craig	Jones	Uncle Willie's BBQ & Fish
David	Lee	Cybelles
Eric	Lim	Dragon Terrace
Ernie	Guerrero	La Tapatia Mexican Restaurants
Javonito	De La Cruz de Morfulleda	OB's Cafe
Jon	Lee	Stuffed Inn
Jon	Guhl	Little Star Pizza
Josh	Levine	Pepples Donuts Inc.
Karen	Bevels	SAML, Inc.
Marsha	Mcbride	Cafe Rouge
Nancy	Deming	Oakland Unified School District
Norman	Riffe	Jed Riffe Catering
Patty	Bonfilio	Pixar Animation Studios
Perry	Harmon	Loards
Pete	Baria	Alameda County Probation
Rebecca	Stevens	Pepples Donuts Inc.
Robert	Law	Oakland School District
Robert	Sill	Arden Wood Inc.
Shirley	Fudge-Mueller	Pacific Gas & Electric Company
Susannah	Blumenstock	Little Star Pizza
Thanu	Chaichana	Tuk Tuk Thai cafe
Tina	Ferguson-Riffe	Smoke Berkeley
Travis	Law	TriMark Economy Restaurant Fixtures
Judy	Chess	UC Berkeley
Monica	Rocchino	The Local Butcher Shop
Rick	Robinson	Gotts Roadside
Ken	Priest	Gotts Roadside
Kit	Dean	Mary's Place

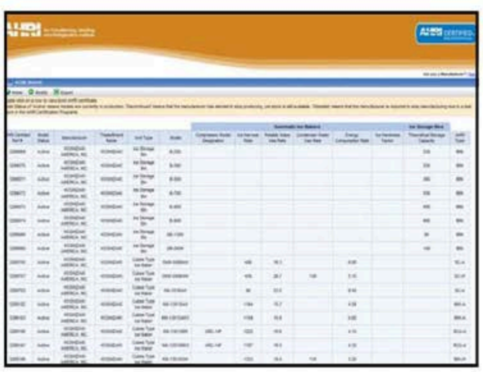
First Name	Last Name	Company / Organization
Faranak	Shariati	Cyprus Restaurant
Don	Nguyen	Saigon Express
Simone	Arpaio	Almare Gelato
Alberto	Malvestio	Almare Gelato
Eric	LaPlante	Hotel Shattuck Plaza
Jake	Shrath	Hotel Shattuck Plaza
David	Lau	Asha Tea House
Jeanne	Boulet	PG&E
Mike	Benzen	Diablo Unified School District
Brian	Fritz	Diablo Unified School District
Quang	Tran	Mrs. Fields Cookies
Charles	Stevenson	UC Berkeley
Amy	Breshears	Comal
Omar	Huerta	Comal

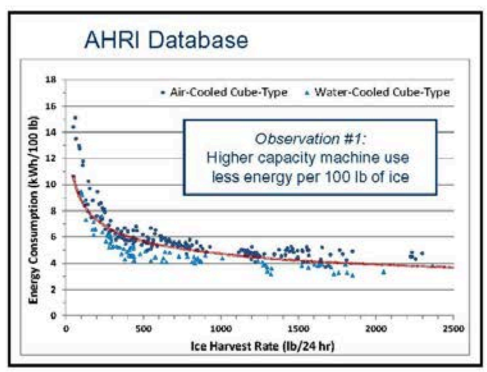
COMAL VENDORS

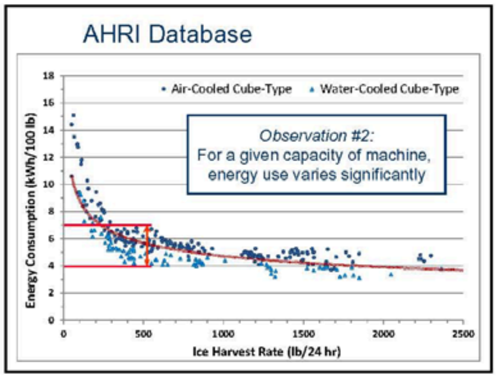
First Name	Last Name	Company / Organization
Leila	Khatapoush	Green Business Program
Nadia	Borisova	EBMUD
Doug	Sampson	PG&E
Joel	Everett	PG&E
Santino	Bernazzani	PG&E
Don	Logsdon	Energy Retrofit Co.
Lori	Broniak	Energy Retrofit Co.
Michelle	Jeffrey	Stopwaste.org
Cassie	Bartholomew	Stopwaste.org
Ruben	Ramirez	PG&E (TVP)
Jennifer	Cogley	City of Berkeley
Rolando	Gonzalez	EBMUD
Charles	Bohlig	EBMUD
Andy	Downing	Greenleaf
Shelly	Haygood	Spindrift
Bradley	Mart	Fog Busters
Rosemary	Logsdon	Energy Retrofit Co.
Mike	Palm	WPD
Pete	Palm	WPD

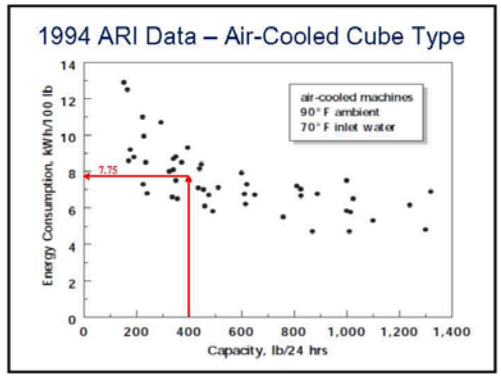
APPENDIX 3: FSTC ICE MACHINE SEMINAR PRESENTATION

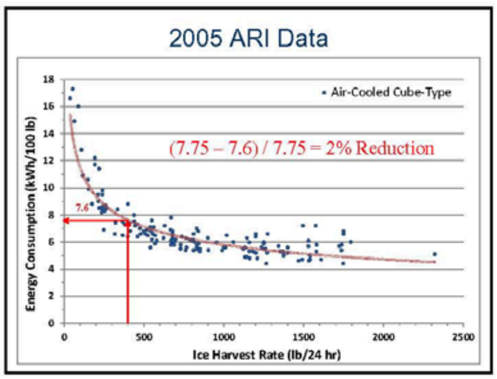


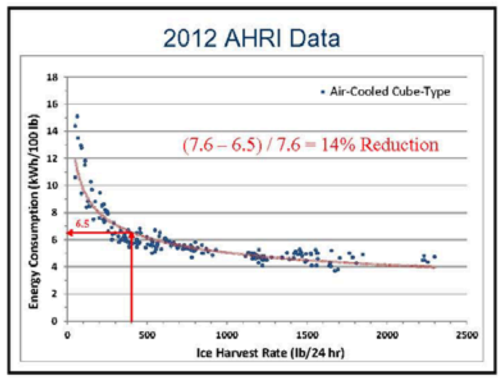


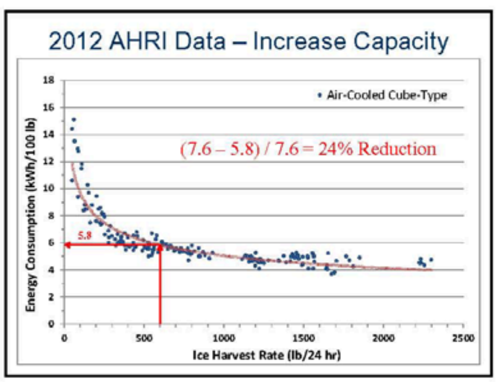


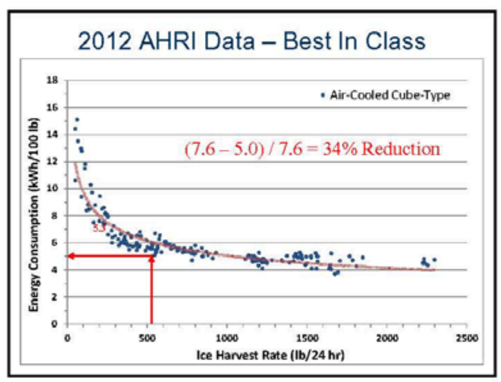

AHRI Database
Air-Cooled Cube-Type
Water-Cooled Cube-Type
Observation #2:
For a given capacity of machine, energy use varies significantly
Energy Consumption (kWh/100 lb)
Ice Harvest Rate (lb/24 hr)


1994 ARI Data – Air-Cooled Cube Type
air-cooled machines
90° F ambient
70° F inlet water
7.75
Energy Consumption, kWh/100 lb
Capacity, lb/24 hrs


2005 ARI Data
Air-Cooled Cube-Type
(7.75 – 7.6) / 7.75 = 2% Reduction
7.6
Energy Consumption (kWh/100 lb)
Ice Harvest Rate (lb/24 hr)


2012 AHRI Data
Air-Cooled Cube-Type
(7.6 – 6.5) / 7.6 = 14% Reduction
6.5
Energy Consumption (kWh/100 lb)
Ice Harvest Rate (lb/24 hr)


2012 AHRI Data – Increase Capacity
Air-Cooled Cube-Type
(7.6 – 5.8) / 7.6 = 24% Reduction
5.8
Energy Consumption (kWh/100 lb)
Ice Harvest Rate (lb/24 hr)


2012 AHRI Data – Best In Class
Air-Cooled Cube-Type
(7.6 – 5.0) / 7.6 = 34% Reduction
Energy Consumption (kWh/100 lb)
Ice Harvest Rate (lb/24 hr)

Ice Machines in Commercial Food Service

- Restaurants will have a minimum of one ice machine, typically between 500-1800 lb/day of ice production.
- Used for food prep, food display and drinks.
- Normal use by staff during business hours results in ice production during the middle of the day, coinciding with peak demand periods.
- Can an ice machine operation be shifted to utility off-peak periods?

What is Load Shifting an Ice Machine?

- Running an ice machine off the utility-peak period, and through the night to produce ice for the next day.
- Ice is stored in the bin and the staff pulls ice during the next day as usual, but no ice is produced to replace what is taken out during the afternoon.
- The ice machine turns back on during non-peak periods (evening and night), filling the bin back up when the energy rates and demand charges are at their lowest.
- A simple timer switch (or built in control) could be used to turn the machine off for the duration of the peak period.
- A more sophisticated Utility demand response program is another option.

What are the benefits of Load Shifting?

- Producing ice off peak could mean a cost saving for the restaurant operator.
- Utilities could shift a significant electrical load off peak, thus reducing their on-peak demand (and generation requirements).

Ice Machine Field Study

- How does the ARI database relate to the real world?
- How much water (and energy) do they really use?
- How much ice do machines typically produce in different types of operations (duty cycle)?
- What do typical load profiles look like?

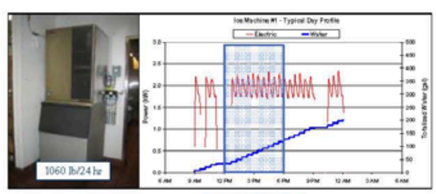
FISHER NICKEL

A Field Study to Characterize Water and Energy Use of Commercial Ice-Cube Machines and Quantify Saving Potential

Food Service Technology Center

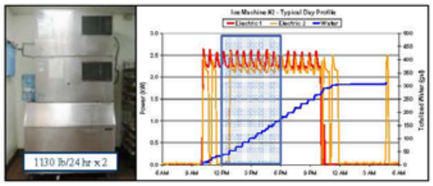
http://www.fishnick.com/publications/appliancereports/special/Ice-cube_machine_field_study.pdf

Ice Machine Field Study



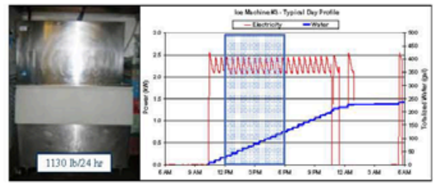
Avg. Duty Cycle = 48%
Max. Duty Cycle = 61%
Load Shift: YES

Ice Machine Field Study



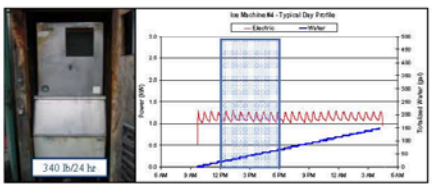
Avg. Duty Cycle = 50%
Max. Duty Cycle = 65%
Load Shift: YES

Ice Machine Field Study



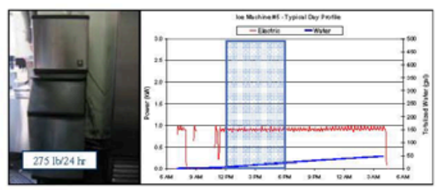
Avg. Duty Cycle = 60%
Max. Duty Cycle = 91%
Load Shift: Maybe

Ice Machine Field Study



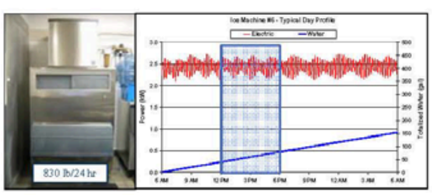
Avg. Duty Cycle = 59%
Max. Duty Cycle = 85%
Load Shift: Maybe

Ice Machine Field Study



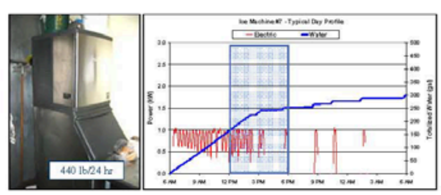
Avg. Duty Cycle = 83%
Max. Duty Cycle = 100%
Load Shift: No

Ice Machine Field Study



Avg. Duty Cycle = 87%
Max. Duty Cycle = 100%
Load Shift: No

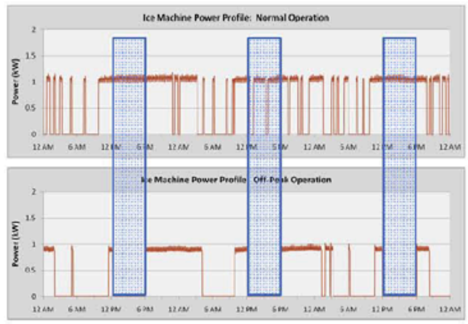
Ice Machine Field Study



Avg. Duty Cycle = 35%
Max. Duty Cycle = 48%
Load Shift: YES

Table 1. Machine Upgrade Results Summary.

	QY0454A Ice Machine	IY0504A Ice Machine
Rated Production Capacity (lb/24 hr)[1]	380	410
Rated Bin Capacity (lb)[1]	310	430
Average Cycle Power (kW)	1.05	0.89
Average Duty Cycle (%)	64	37
Average Cycle Time (min)	15.7	13.5
Average Cycle Harvest Weight (lb)	4.25	4.65
Average Cycle Water Use (gal)	1.19	1.12
Estimated In-Site Production Capacity (lb/24 hr)[2]	390	497
Energy Consumption Rate (kWh/100 lb)[2]	6.54	4.34
Potable Water Use Rate (gal/100 lb)[3]	28.0	24.0
Projected Annual Energy Use (kWh)[4]	4,710	3,130
Projected Annual Water Use (gal)[4]	20,130	17,290
Annual Energy Cost[5]	$847	$563
Annual Water Cost[6]	$135	$116



The Bottom Line

Average Cycle Power Reduction (kW)	–	0.16
Energy Saving (kWh/100 lb)	–	2.20
Energy Percentage Saving	–	33.6%
Annual Energy Saving (kWh)	–	1,580
Annual Energy Cost Saving	–	$284
Water Saving (gal/100 lb)	–	4.0
Water Percentage Saving	–	13.8%
Annual Water Saving (gal)	–	2,840
Annual Water Cost Saving	–	$19
Annual Energy and Water Cost Saving	–	$303
Peak Demand Reduction (kW)[1]	–	1.05

If the facility in this study were on a time-of-use rate (which will take effect in 2013) the total cost saving of installing the more efficient ice machine combined with load shifting would be approximately $500 per year.

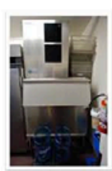
From the utilities perspective, there would be a 1,580 kWh/yr energy saving with an avoided peak demand of 1.05 kW.

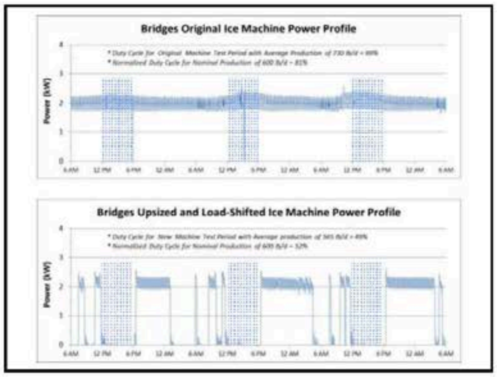
Energy Efficient Ice Machines Demonstration Showcase

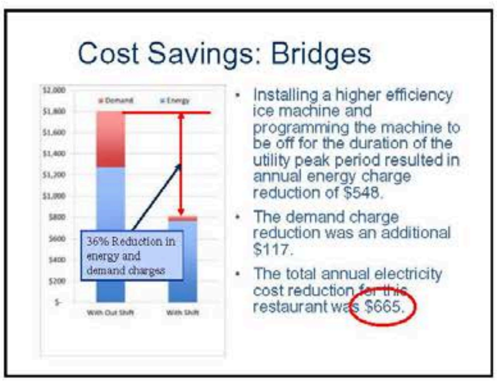
Identified four restaurants to install energy efficient ice machines with integrated programmable controls set to turn unit off during peak utility rate period

Bridges Restaurant, Danville CA

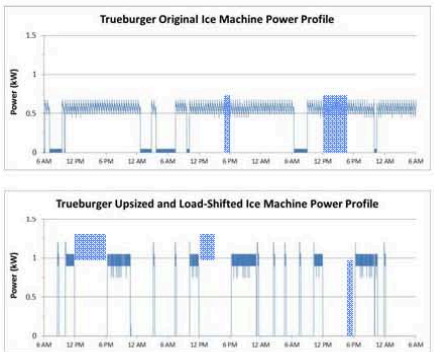
Ice Machine Energy Use		
	Original Machine	New Machine
Rated Production (lb/24 hr)	772	1,180
Rated Energy Use (kWh/100 lb)	6.4	4.62
Normalized Duty Cycle (%)	82	52
Annual Energy Savings (kWh)	-	4,270
Peak Demand Reduction (kW)	-	2.0



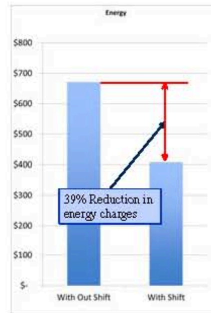




Ice Machine Energy Use		
	Original Machine	New Machine
Rated Production (lb/24 hr)	147	410
Rated Energy Use (kWh/100 lb)	10.27	5.73
Normalized Duty Cycle (%)	89	29
Annual Energy Savings (kWh)	-	1,520
Peak Demand Reduction (kW)	-	.52



Trueburger
Cost Savings:
$271



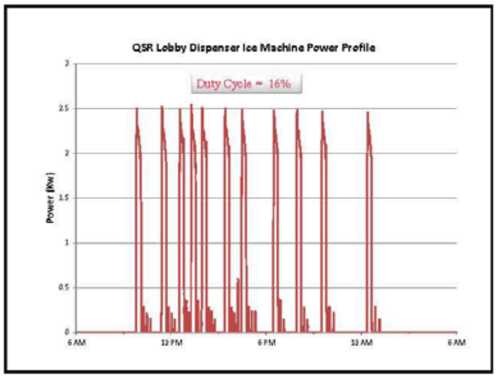
How do you know if your ice machine is a candidate?

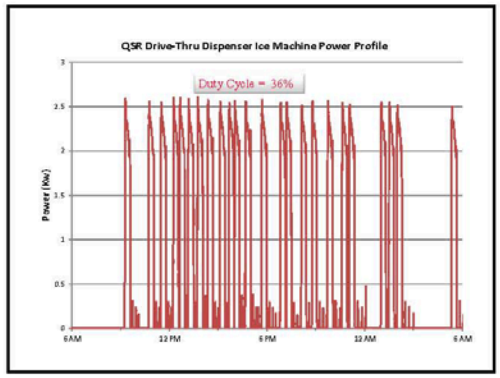
You may need to monitor its operation.

Peak Duty Cycle of 51%

14-Apr	3:19:48	3.32	13.82%
15-Apr	5:49:23	5.82	24.24%
16-Apr	5:01:22	5.02	20.90%
17-Apr	4:12:14	4.20	17.50%
18-Apr	5:43:21	5.72	23.82%
19-Apr	7:02:48	7.03	[illegible]
20-Apr	12:20:35	12.33	51.39%
21-Apr	11:03:27	11.05	[illegible]
22-Apr	6:58:49	6.97	29.03%
23-Apr	7:48:29	7.80	32.50%
24-Apr	3:59:56	3.98	16.60%
25-Apr	8:59:29	8.98	37.43%
26-Apr	10:10:25	10.17	42.36%
27-Apr	3:53:46	3.88	16.18%
28-Apr	6:36:31	6.60	27.50%
29-Apr	3:59:18	3.98	16.60%
30-Apr	5:26:14	5.43	22.64%

What about soda machines?





The Potential…

- Ice machines represent one of the few pieces of electrical equipment in a restaurant that can be turned off for a period of time within the context of "utility demand response" or "time-of-use" without compromising the foodservice operation.
- Thanks to the ice storage bin, ice machines have the ability to make ice during periods of the day that are not coincident with the either usage of ice or the utility peak.

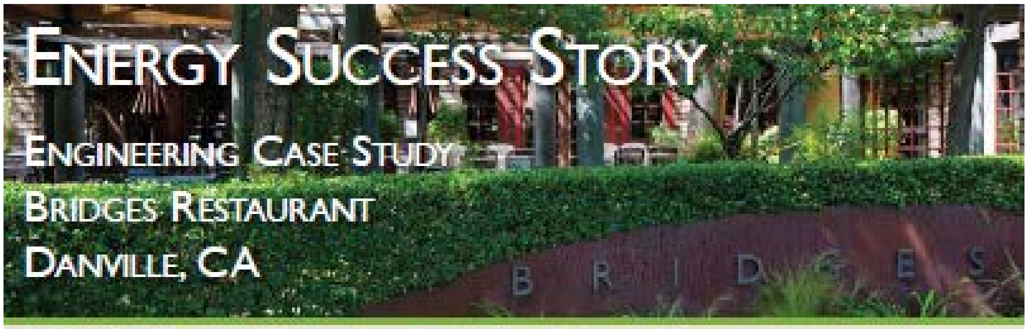
A California Utility Perspective!

- In California – potentially 75,000 existing ice machines in commercial food service (out of 150,000) could be moved off peak – immediately!
- Estimated 1.0 kW probable Peak demand reduction per machine.
- 75 Megawatt on-peak power avoided!
- Huge benefit to electric utilities (California's solar goal is 20 MW by 2020)

The Future

In the foreseeable future, it is conceivable that ice making in all restaurants will be during non–peak utility periods, and in many cases, during the off-peak, cooler hours of the night.

APPENDIX 4: CASE STUDY FACT SHEET—BRIDGES



PG&E Food Service Technology Center
Audit & Action demonstration project

Bridges Restaurant's ice machine was replaced with an ENERGY STAR® qualified ice machine, that consumes less energy and uses it during non-utility-peak hours when energy costs and demand charges are lower. The new ice machine reduced annual operating costs by $812. Along with the annual savings of the new ice machine, Bridges capitalized on a $200 PG&E California Energy Wise Rebate to offset the initial purchase cost, giving them an incremental payback of 30 months.

Ice Machine – Calculated Energy Use

	Original Machine	Replacement Machine with Integrated Timer
Ice Harvest Rate (lbs/24hr)	772	1,180
Energy Consumption Rate (kWh/100lb)	6.4	4.62
Duty Cycle (%)	81.5	51.9
Annual Energy Use Savings (kWh)	–	4,270
Demand Reduction (kW)	–	2.0
Hours Shifted to Non-Peak	0	6
Annual Operating Cost Savings ($)[1]	–	629

Bridge's original ice machine.

ENERGY STAR replacement ice machine.

APPENDIX 5: CASE STUDY FACT SHEET—TRUEBURGER

PG&E Food Service Technology Center *Audit & Action* demonstration project

Trueburger's ice machine was replaced with an ENERGY STAR® qualified ice machine, that consumes less energy and uses it during non-utility-peak periods when energy costs and demand charges are lower. The new ice machine reduced annual operating costs by $271. Along with the annual savings of the new ice machine, Trueburger capitalized on a $200 PG&E California Energy Wise Rebate to offset the initial purchase cost.

Ice Machine – Calculated Energy Use

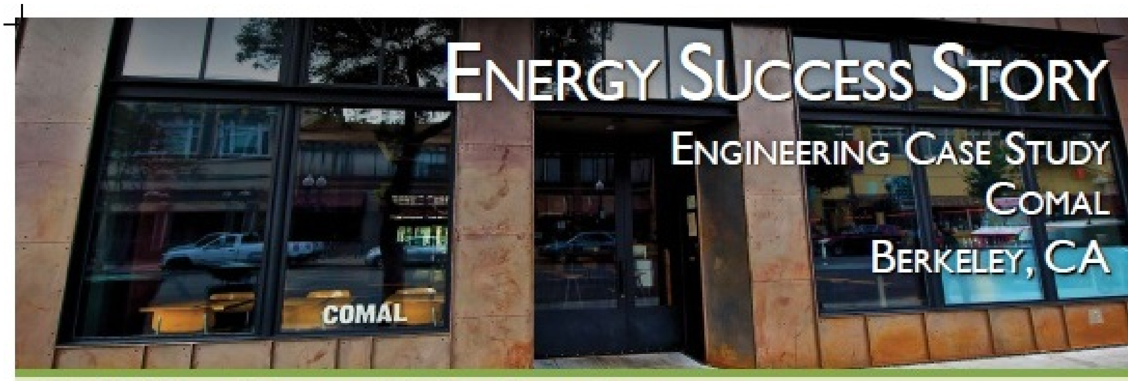
	Original Machine	Replacement Machine with Integrated Timer
Ice Harvest Rate (lb/24hr)	147	410
Energy Consumption Rate (kWh/100 lb)	10.3	5.73
Duty Cycle (%)	88.7	29.4
Annual Energy Use Savings (kWh)	4,050	2,530
Demand Reduction (kW)	–	0.52
Hours Shifted to Non-Peak	0	6
Annual Operating Cost Savings ($)[1]	–	271

[1] Electric utility costs based on PG&E A-1 rate schedule.

Trueburger's original ice machine.

ENERGY STAR replacement ice machine.

APPENDIX 6: CASE STUDY FACT SHEET—COMAL



ENERGY SUCCESS STORY

ENGINEERING CASE STUDY
COMAL
BERKELEY, CA

PG&E Food Service Technology Center Design Support Showcase Program

Comal's Andrew Hoffman and Todd Bell (FSTC) use the PG&E My Energy website to review Comal's energy use history.

Once a completely gutted commercial space in the heart of downtown Berkeley, Comal is a shining example of what can be accomplished when a passion for sustainability, energy efficiency, long-term profitability and engineering knowhow collide. Comal's Principals John Paluska and Andrew Hoffman along with Abueg Morris Architects and kitchen designer Alec Bauer of Kitchen Restaurant + Bar Specialists, have created a unique and exciting restaurant that incorporates total sustainable design and best practice. Supporting the energy-efficient design from the earliest stages were PG&E Customer Relationship Manager Santino Bernazzani and Sr. Energy Analyst Todd Bell of the utility's Food Service Technology Center (FSTC).

From the first design consultation to reviewing subsequent equipment schedules and mechanical drawings for Comal, Bell and the FSTC team ensured that the energy and water-using systems were efficient and where applicable, eligible for PG&E California Energy Wise rebates. Bauer selected an Accutemp boilerless steamer and Blodgett convection oven for Comal's steaming and baking needs. These ENERGY STAR® and rebate qualified appliances will annually save 15,000 kWh and 210 therms. The Accutemp steamer's boilerless steaming technology will save Comal 18,000 gallons of water per year versus a boiler-based type steamer.

"I highly recommend (FSTC) to everyone I know who wants to open a restaurant, I tell them its a great resource."

Bell identified and replaced a low-efficiency gas fryer on the hotline with an ENERGY STAR fryer under the PG&E Emerging Technologies (ET) appliance demonstration project to promote energy-efficient cooking appliances. Pre and post energy monitoring of the original and replacement fryers showed an 825 therm reduction that will save Comal $700 per year in operating costs.

California Energy Wise rebate qualified gas convection oven.

The appliances on the hotline operate in perfect harmony with the hoods above, whose exhaust fans are controlled by Captive Aire's demand ventilation energy management system. This temperature sensing fan control technology modulates fan speeds to match the cooking load of the appliances under the hood. This delivers significant savings, especially during periods when the appliances are idle or lightly used.

California Energy Wise rebate qualified gas fryer.

On the refrigeration side, the new walk-in cooler is equipped with all the features prescribed in the CA Title 20 Appliance Energy Efficiency Standard – electronically commutated evaporator fan motors, a plastic strip curtain and auto-door closer. Nugget ice production comes from a Manitowoc top tier ENERGY STAR ice machine and the True reach-in refrigerators are best in class as well. A high-efficiency, A.O. Smith condensing water heater supplies hot water to the low flow pre-rinse sprayer and ENERGY STAR dishmachine. This energy efficient water heater will save Comal $1,000 annually in water heating cost when compared to a non-condensing, standard-efficiency water heater common in today's restaurants..

LED lamps are featured in the dining room and kitchen including the exhaust hoods, the modular cans over the dining counter, bar task lighting and in the strip lighting along the dining room walls. These fixtures illuminate work and dining surfaces at a fraction of the cost of traditional incandescent or halogen lamps and have a 100-fold longer lifespan.

The use of energy and water efficient technologies is transparent to staff and customers, which shows that restaurant operators like Paluska and Hoffman can confidently specify efficient equipment and best practices without sacrificing performance.

Savings by Managing Energy

Sponsored by the PG&E Emerging Technologies (ET) Program

California Energy Wise Rebate Qualified Appliances
Total Rebates[1]: $4,599

- Accutemp steamer – $1,250
- Blodgett convection oven – $500
- Pitco fryer – $749
- Manitowoc ice machine – $100
- True reach-in refrigerators ($50/unit) – $200
- Captive Aire demand ventilation energy management system ($300/HP) – $1,800

Energy Efficient Technologies

- A.O. Smith high efficiency condensing water heater
- T&S Brass low flow pre-rinse spray valve
- LED lamps in exhaust hood fixtures
- Recessed modular LED fixtures
- Electronically commutated walk-in cooler evaporator fan motors

Best Practice Measures

- Dishmachine exhaust hood fan interlocked with dishmachine
- Ice machines operate on time clocks to shut them off during the peak utility rate period
- Coffee machine turned off during hours of close
- Dinning room light fixtures turned off during non-service day time hours due to daylight harvesting
- Walk-in cooler door equipped with plastic strip curtain and auto door closer
- Hot water recirculation line operates on a time clock to shut it off during hours of close

[1] fishnick.com/saveenergy/rebates/

APPENDIX 7: FOCUS GROUP AGENDA

Food Service
Technology Center
Celebrating 25 Years of
Energy Efficiency in
Commercial Foodservice

FSTC Industry Focus Group Meeting Agenda
Ice Machine Energy Efficiency and Load Shifting Potential

Thursday, November 8, 2012
2:00 pm to 5:00 pm

Welcome to the PG&E Food Service Technology Center	Charlene Spoor
Introductions and background of participants	All
Objectives and scope of the ice machine initiative	Don Fisher
Results of field monitoring, equipment upgrades and load-shifting experiences to date	Todd Bell/ Angelo Karas
Demand response focus in Southern California	Carlos Haiad, SCE
Discussion of issues and hurdles to market adoption	Participants
Outline the strategy/next steps to realize potential for energy efficiency and load-shifting and/or demand response in the commercial foodservice sector	Participants
Adjourn	

Please contact Don Fisher at 925-866-5770 or dfisher@fishnick.com to confirm participation or to discuss scope the agenda.

12949 Alcosta Boulevard, Suite 101, San Ramon, CA 94583 1.800.398.3782 Direct Line 925.866.2844

APPENDIX 8: FOCUS GROUP LIST OF ATTENDEES

First Name	Last Name	Company/Organization
Ashley	Devine	Norm's Refrigeration
Pete	McLaughlin	Norm's Refrigeration
Dennis	Hunt	Contra Costa Climate Control
James	Alnutt	Contra Costa Climate Control
Andre	Saldivar	SCE
Carlos	Haiad	SCE
Martin Vu	SCE (Phone)	
Janis	Heppel	SDGE (Phone)
Greg	Gummere	Manitowoc
Pete	Palm	WPD
David	Harpring	YUM
Charlene	Spoor	PGE
Tom	Wright	Hoshizaki
Steve	Bragg	Hoshizaki
Albert	Chiu	PGE
Jonathan	Burrows	PGE
Don	Fisher	FNi/FSTC
Adam	Cornelius	FSTC
Todd	Bell	FSTC
Angelo	Karas	FSTC

APPENDIX 9: RATE SCHEDULES

Rate Schedule	Customer Charge	Season	Time-of-Use Period	Demand Charge (per kW)			Time-of-Use Period	Total Energy Charge (per kWh)			PDP[1/] Charges	PDP[2/] Credits DEMAND (per kW)			PDP[2/] Credits ENERGY (per kWh)			"Average" Total Rate[3/] (per kWh)
A-1	Single Phase Service per meter/day =$0.32854 Polyphase Service per meter/day =$0.65708	Summer		-				$0.20495			-	-			-			$0.18531
		Winter		-				$0.14344			-	-			-			
A-1 TOU	Single Phase Service per meter/day =$0.32854 Polyphase Service per meter/day =$0.65708	Summer		-			On peak	$0.22006			$0.60	-			($0.00991)			
							Part Peak	$0.21324							($0.00991)			
							Off Peak	$0.19250							($0.00991)			
		Winter		-			Part Peak	$0.15102				-			-			
							Off Peak	$0.13642										
A-6 TOU	Single phase service per meter/day =$0.32854; Polyphase service per meter/day =$0.65708. Plus Meter charge =$0.20107per day for A6 or A6X; =$0.05914 per day for A6W[5/]	Summer		-			On peak	$0.44432			$1.20	-			($0.09283)			$0.17650
							Part Peak	$0.22500							($0.01857)			
							Off Peak	$0.13661							-			
		Winter		-			Part Peak	$0.15166				-			-			
							Off Peak	$0.12661										
				Secondary	Primary	Transmission		Secondary	Primary	Transmission		Secondary	Primary	Transmission	Secondary	Primary	Transmission	
A-10 (Table A)	$4.59959 per meter per day	Summer		$12.12	$11.35	$7.43		$0.13741	$0.12857	$0.10452	-	-	-	-	-	-	-	$0.15876
		Winter		$5.63	$5.84	$4.13		$0.10257	$0.09835	$0.08604								
A-10 TOU (Table B)	$4.59959 per meter per day	Summer		$12.12	$11.35	$7.43	Peak	$0.15023	$0.13927	$0.11425	$0.90	($2.11)	($1.99)	($2.23)	($0.00875)	($0.00899)	($0.00648)	Secondary $0.15885 Primary $0.14765 Transmission $0.12142
							Part-Peak	$0.14442	$0.13513	$0.11047					($0.00875)	($0.00899)	($0.00648)	
							Off-Peak	$0.12677	$0.11931	$0.09610					($0.00875)	($0.00899)	($0.00648)	
		Winter		$5.63	$5.84	$4.13	Part-Peak	$0.11034	$0.10469	$0.09189		-	-	-	-	-	-	
							Off-Peak	$0.09520	$0.09231	$0.08049								
E-19 TOU	Meter charge: =$4.77700/day for E19 V or X; =$4.63507/day for E19W[4/]; =$19.71253/day for E19S mandatory; =$32.85421/day for E19P mandatory; =$59.13758/day for E19T mandatory	Summer	Max. Peak	$14.59	$14.37	$12.24	Peak	$0.13357	$0.12324	$0.08177	$1.20	($6.35)	($6.09)	($5.54)	$0.00000	$0.00000	$0.00000	Secondary $0.13878 Primary $0.13156 Transmission $0.11466
			Part Peak	$3.41	$3.13	$2.71	Part Peak	$0.09502	$0.08980	$0.07843		($1.37)	($1.18)	($1.23)	$0.00000	$0.00000	$0.00000	
			Maximum	$11.85	$9.23	$5.35	Off Peak	$0.06978	$0.06988	$0.06678		-	-	-	-	-	-	
		Winter	Part Peak	$0.21	$0.40	$0.00	Part Peak	$0.08991	$0.08603	$0.07725		-	-	-	-	-	-	
			Maximum	$11.85	$9.23	$5.35	Off Peak	$0.07267	$0.07227	$0.06801								

[1/]Peak Day Pricing (PDP) (Consecutive Day and Four-Hour Event Option). All Usage During PDP Event. See specific tariff for further details.
[2/]Peak Day Pricing (PDP) (Consecutive Day and Four-Hour Event Option). See specific tariff for further details.
[3/]Average rates based on estimated forecast. Average rates provided only for general reference, and individual customer's average rate will depend on its applicable kW, kWh, and TOU data.
[4/]Effective May 1, 2006, the voluntary TOU one time reprogramming charge of $87 if there is a TOU meter already present, and one time $443 meter installation charge if there is no TOU meter, were eliminated.
[5/]The lower daily TOU meter charge continues to apply to customers who were on Rate W as of May 1, 2006. Rate X applies to all other customers.
This table provided for comparative purposes only. See current tariffs for full information regarding rates, application, eligibility, average rate limiter and additional options.

APPENDIX 10: TIME-OF-USE PERIODS

A-1, A-10 and E-19 Time-of-Use Periods

Summer Period A (May-October)

Peak:	12:00 noon to 6:00 pm	Monday through Friday (except holidays)
Partial-Peak:	8:30 am to 12:00 noon	Monday through Friday (except holidays)
	6:00 pm to 9:30 pm	Monday through Friday (except holidays)
Off-Peak:	9:30 pm to 8:30 am	Monday through Friday (except holidays)
	All Day	Saturday, Sunday, and Holidays

Winter Period B (November-April)

Partial-Peak:	8:30 am to 9:30 pm	Monday through Friday (except holidays)
Off-Peak:	9:30 pm to 8:30 am	Monday through Friday (except holidays)
	All Day	Saturday, Sunday, and Holidays

REFERENCES

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[3] Air-Conditioning, Heating, and Refrigeration Institute. 2012. AHRI Directory of Certified Automatic Commercial Ice-Makers and Ice Storage Bins. (http://www.ahridirectory.org/ahriDirectory/pages/home.aspx)

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[8] Zabrowski, D. and L. Mills. 2010. *Characterizing the energy efficiency potential of gas-fired commercial foodservice equipment.* Final Report. California Energy Commission: Contract No.: 500-06-028. San Ramon (CA): Prepared for the California Energy Commission, Public Interest Energy Research (PIER) Program.