**Work Paper PGECOFST108**

**Commercial Ice Machines**

**Revision # 5**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Commercial Ice Machines**

**Measure Codes F200, F201, F202, F203, F204**

# At-a-Glance Summary – Commercial Ice Machines

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Applicable Measure Codes:** | **F200** | **F201** | **F202** | **F203** | **F204** |
| **Measure Description:** | Commercial Ice Machines 101-300lbs/day | Commercial Ice Machines 301-500lbs/day | Commercial Ice Machines 501-1000lbs/day | Commercial Ice Machines 1001-1500lbs/day | Commercial Ice Machines >1501lbs/day |
| **Energy Impact Common Units:** | Per Unit/Ice Machine | Per Unit/Ice Machine | Per Unit/Ice Machine | Per Unit/Ice Machine | Per Unit/Ice Machine |
| **Base Case Description:** | Source: Title 20, Commercial Ice Machine 101-300lbs/day | Source: Title 20, Commercial Ice Machine 301-500lbs/day | Source: Title 20, Commercial Ice Machine 501-1000lbs/day | Source: Title 20, Commercial Ice Machine 1001-1500lbs/day | Source: Title 20, Commercial Ice Machine >1501lbs/day |
| **Base Case Energy Consumption:** | Source: PG&E Calculations.  5,366 kWh/yr. | Source: PG&E Calculations.  7,468 kWh/yr. | Source: PG&E Calculations.  12,462 kWh/yr. | Source: PG&E Calculations.  17,452 kWh/yr. | Source: PG&E Calculations.  24,432 kWh/yr. |
| **Measure Energy Consumption:** | Source: PG&E Calculations.  4,561 kWh/yr. | Source: PG&E Calculations.  6,351 kWh/yr. | Source: PG&E Calculations.  10,594 kWh/yr. | Source: PG&E Calculations.  14,851 kWh/yr. | Source: PG&E Calculations.  20,791 kWh/yr. |
| **Energy Savings**  **(Base Case – Measure):** | Source: PG&E Calculations.  805 kWh/yr. | Source: PG&E Calculations.  1,117 kWh/yr. | Source: PG&E Calculations.  1,868 kWh/yr. | Source: PG&E Calculations.  2,601 kWh/yr. | Source: PG&E Calculations.  3,641 kWh/yr. |
| **Costs Common Units:** | Ice Machine | Ice Machine | Ice Machine | Ice Machine | Ice Machine |
| **Base Case Equipment Cost ($/unit):** | Source: PG&E Calculations.  $2,464 | Source: PG&E Calculations.  $2,407 | Source: PG&E Calculations.  $4,312 | Source: PG&E Calculations.  $4,099 | Source: PG&E Calculations.  $7,191 |
| **Measure Equipment Cost ($/unit):** | Source: PG&E Calculations.  $2,775 | Source: PG&E Calculations.  $2,673 | Source: PG&E Calculations.  $4,561 | Source: PG&E Calculations.  $4,688 | Source: PG&E Calculations.  $8,130 |
| **Measure Incremental Cost ($/unit):** | Source: PG&E Calculations.  $311 | Source: PG&E Calculations.  $266 | Source: PG&E Calculations.  $249 | Source: PG&E Calculations.  $589 | Source: PG&E Calculations.  $939 |
| **Effective Useful Life (years):** | **10 years**  (DEER EUL\_ID: Cook-IceMach)  Source: [www.Deeresources.com](http://www.Deeresources.com) | **10 years**  (DEER EUL\_ID: Cook-IceMach)  Source: [www.Deeresources.com](http://www.Deeresources.com) | **10 years**  (DEER EUL\_ID: Cook-IceMach)  Source: [www.Deeresources.com](http://www.Deeresources.com) | **10 years**  (DEER EUL\_ID: Cook-IceMach)  Source: [www.Deeresources.com](http://www.Deeresources.com) | **10 years**  (DEER EUL\_ID: Cook-IceMach)  Source: [www.Deeresources.com](http://www.Deeresources.com) |
| **Measure Application Type:** | ROBNC (ROB or NC) | ROBNC (ROB or NC) | ROBNC (ROB or NC) | ROBNC (ROB or NC) | ROBNC (ROB or NC) |
| **Net-to-Gross Ratios:** | **0.6** (DEER NTGR ID: Com-Default>2yrs)  Source: DEER 2016 | **0.6** (DEER NTGR ID: Com-Default>2yrs)  Source: DEER 2016 | **0.6** (DEER NTGR ID: Com-Default>2yrs)  Source: DEER 2016 | **0.6** (DEER NTGR ID: Com-Default>2yrs)  Source: DEER 2016 | **0.6** (DEER NTGR ID: Com-Default>2yrs)  Source: DEER 2016 |
| **Important Comments:** |  |  |  |  |  |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Workpaper Revision # | Date: MM/DD/YY | Description | Author (Company) |
| Revision 0 | 12/18/2007 | Original work paper --Commercial Ice Machines PGECOFST108 R0.doc | David Zabrowski (Fisher-Nickel, inc.) |
| Revision 1 | 12/20/2007 | Change in baseline due to Title 20 & Added a second Tier | David Zabrowski (Fisher-Nickel, inc.) |
| Revision 2 | 2/10/2010 | Changes to EUL, NTG language and references due to 2008 DEER, costs updated | David Zabrowski, Lauren Mills (Fisher-Nickel, inc.), Steve Blanc PG&E |
| Revision 3 | 05/30/2012  8/24/2012 | Updated NTG, EUL and savings analysis, pricing and incremental costs. Removed product codes F154-F159 for Energy Star machines. Removed Energy Star and CEE criteria. Consolidated 101-300 lb with 300-500 lb, and 501-1000lb with >1500 lb ice machines into F200 to F204 respectively.  Updated BLD, CZ and VIN to ANY per READI (Remote Ex-Ante Database Interface) requirements | Kong Sham (Fisher-Nickel, inc.)  Charlene Spoor (PG&E) |
| Revision 4 | 6/15/2014 | Updated to new WP template, modified references to DEER2014. | Charlene Spoor (PG&E) |
| Revision 5 | 4/1/2016  8/18/2016 | - Ex Ante Format Update  -Updated calc tables to match online calcualtor  - Included formulas and incorporated examples  - Updated references  - Removed Direct Install from excel spreadsheet since it did not match the workpaper narrative | Sherry Hu (PG&E)  Vern Smith (Smith Energy Engieers)  Mini Damodaran (PG&E), Reviewer: Alina Zohrabian (PG&E) |
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# Section 1 General Measure & Baseline Data

## 1.1 Product Measure Description & Background

This work paper documents the rationale for the Ice Machine measure as listed in the Commercial Food Service Catalog of Pacific Gas and Electric Company’s Customer Energy Efficiency Mass Market Rebate Program.

***Catalog Description –*** This specification covers machines generating 60 grams (2 oz.) or lighter ice cubes, as well as flaked, crushed, and fragmented ice makers. Performance data is based on testing to Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 810[[1]](#endnote-1). Only air-cooled machines (self-contained, icemaker heads, or remote condensing) are eligible. The efficiency specifications must meet the requirements listed in Table 1. Visit [ahrinet.org](http://www.ahrinet.org/Home.aspx) for product information and testing procedures. To qualify, the entire AHRI tested Ice Making system must be purchased to qualify. Remote machines must be purchased with qualifying remote condenser or remote condenser/compressor unit.

***Program Restrictions and Guidelines***

***Terms and Conditions:*** This incentive applies towards the purchase of new or replacement energy efficient air-cooled ice machines. Used or rebuilt equipment is not eligible. Customers must provide proof that the appliance meets the energy efficiency specifications listed in Table 1.

This specification covers machines generating 60 grams (2 oz.) or lighter ice cubes, as well as flaked, crushed, or fragmented ice machines that meet the Super Energy Efficiency thresholds by Ice harvest rate (IHR). Only air cooled machines (icemaker heads, self-contained units, and remote condensing units) are eligible for incentives. Performance data is based on AHRI Standard 810.

The rebate for measures F200 to F204 is downstream provided to the customer at the time of sale upon receipt of application and invoice. This is not a direct install program.

Table - Super-Efficient Ice Maker Energy Efficiency Requirements

|  |  |  |
| --- | --- | --- |
| Equipment Type | Ice Harvest Rate  (lbs. ice/24 hrs.) | Maximum Energy Use  (kWh/100 lbs. ice) |
| Ice Maker Head (IMH) | < 450 | 8.72 – 0.0073 x H\* |
| ≥ 450 | 5.86 – 0.0009 x H\* |
| Remote Condensing Unit (RCU) | < 1,000 | 7.52 – 0.0032 x H\* |
| ≥ 1,000 | 4.34 |
| Self-Contained Unit (SCU) | < 175 | 15.3 – 0.0399 x H\* |
| ≥ 175 | 8.33 |

\*H = Ice Harvest Rate (IHR) for the commercial ice machine as determined by applying ARI Standard 810.

***Market Applicability:*** Hospitals account for 39.4 percent of all commercial icemaker purchases, followed by hotels (22.3 percent), restaurants (13.8 percent), retail outlets (8.5 percent), schools (8.5 percent), offices (4.3 percent), and grocery stores (3.2 percent)[[2]](#endnote-2).

## 1.2 Product Technical Description

Commercial Icemakers use a substantial amount of energy in order to freeze water and maintain the ice as separate cubes. Reductions are possible with the use of high efficiency motors in condenser fans and compressors, thicker insulation and reduced evaporator thermal cycling. The energy use in a commercial icemaker varies from product to product, depending on the condenser and the type of ice produced.

The average annual energy use of a 400 lbs./day air-cooled icemaker is 7,500 kWh with a potential increase in efficiency of 15 percent. Approximately 61 percent of the commercial ice machine market is self-contained cube making units; the rest are ice making heads and remote condensing units[[3]](#endnote-3). The PG&E Food Service Technology Center (FSTC) estimates that there are more than 173,000 ice machines in California, with up to 100,000 in PG&E service territory.

## 1.3 Measure Application Type

The Database for Energy Efficiency Resources (DEER) developed by the California Public Utilities Commission defines the measure application type as shown in the table below.

Table  - Measure Application Type[[4]](#endnote-4)

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ROB | Replace on Burnout | *Measure technology applied instead of Code/Standard technology at the time of replacement, Single baseline (above code), incremental or full costs* |
| NC | New Construction | *Measure technology applied instead of Code/Standard technology during new construction, Single baseline (above code), incremental or full costs* |
| ROBNC | ROB or NC | *Measure technology applied instead of Code/Standard technology at the time of replacement or new construction, Single baseline (above code), incremental or full costs* |

Commercial ice machines are classed as suitable for ROB, or NC installations. This work paper will only deal with the ROB or NC applications.

## 1.4 Product Base Case and Measure Case Data

Ice Machines are governed under Title 20: State of California Title 20 Appliance Efficiency Regulation listed below in Section 1.4.2. This work paper uses Title 20 requirements for energy efficiency as the baseline for commercial ice machines[[5]](#endnote-5).

### 1.4.1 DEER Base Case and Measure Case Information

The DEER database for the program years does not contain information on energy use, savings, or equipment costs for an energy-efficient ice machine measure. There is a reference in DEER for Effective Useful Life (EUL) for Ice machine as shown table below[[6]](#endnote-6).

Table - DEER Effective Useful Life

|  |  |  |
| --- | --- | --- |
| **EULID** | **Description** | **EUL (yrs.)** |
| Cook-IceMach | Ice Machine | 10 |

**Net-to-Gross Ratio (NTGR) Assumptions**

DEER NTGR Values file does not specifically list commercial food service appliances The default used for non-residential measures is Com-Default for measures offered more than 2 years[[7]](#endnote-7).

All applicable DEER based Net-to-Gross ratios for programs that may be used by this measure are shown inTable 1.

Table - DEER Net-to-Gross Ratios

|  |  |
| --- | --- |
| **NTG** | **NTGR\_kWh** |
| Com Default>2 yrs. | 0.6 |

**In Service Rate/ First Year Installation Rate**

The Installation Rate (IR) values were obtained using the DEER READI tool. The relevant IR values for the measures in this workpaper are in Table 5.

Table - Installation Rate

|  |  |  |  |
| --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Com | 1 |

### 1.4.2 Codes & Standards Requirements

***California Title 20:*** This measure does fall under Title 20 of the California Energy Regulations. Under this regulation, the following is required: all commercial ice machines manufactured on or after January 1, 2010 are required to meet the specifications outlined in the table below.

Table - Title 20 Energy Efficiency Requirements for Air-Cooled Commercial Ice Machines

|  |  |  |
| --- | --- | --- |
| Equipment Type | Ice Harvest Rate  (lbs. ice/24 hrs.) | Maximum Energy Use  (kWh/100 lbs. ice) |
| Ice Maker Head (IMH) | < 450 | 10.26 – 0.0086 × H a |
| ≥ 450 | 6.89 – 0.0011 × H a |
| Remote Condensing Unit (RCU) without remote compressor | < 1,000 | 8.85 – 0.0038 × H a |
| ≥ 1,000 | 5.10 |
| Remote Condensing Unit (RCU) with remote compressor | < 934 | 8.85 – 0.0038 × H a |
| ≥ 934 | 5.30 |
| Self-Contained Unit (SCU) | < 175 | 18.0 – 0.0469 × H a |
| ≥ 175 | 9.80 |

a H = Ice Harvest Rate (IHR) for the commercial ice machine as determined by applying AHRI Standard 810.

***California Title 24:*** This measure does not fall under Title 24 of the California Energy Regulations

***Federal Standards:*** DOE has regulations for ice machine since 2010[[8]](#endnote-8) but the Title 20 regulations are more stringent and Title 20 is used as baseline.

***Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 810 (I-P):*** AHRI Standard 810, Performance Rating of Automatic Commercial Ice-Makers, is considered the industry standard for estimating commercial ice machine energy use. The AHRI test data was used to estimate the energy consumption of the base case equipment.

### 1.4.3 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

There were no specific EM&V studies identified that addressed cooking measures in the commercial sector.

### 1.4.4 Assumptions and Calculations from other sources – Base and Measure Cases

Assumptions that were not taken directly from DEER 2016 are listed below.

**Energy Savings Assumption (ΔW):** The Base case for both existing units and above code savings were taken from the California Energy Commission (CEC) Title 20 regulations for commercial ice machines. As listed in section 1.4.2.

### 1.4.5 Time-of-Use Adjustment Factor

The TOU adjustment factor for all non A/C measures is 0.

# Section 2 Calculation Methods

## 2.1 Electric Energy Savings Estimation Methodologies

In an analysis of the range of products currently on the market, American Council for an Energy Efficient-Economy (ACEEE) research indicates that the highest performing models on the market are 18.46 percent more efficient than the worst performing models[[9]](#endnote-9). If the difference between worst and best performing machines is 18.46%, it is assumed in the savings calculation that energy efficient machines are on average 15% more efficient than baseline models.  Manufacturers have also indicated that they have the technical capability to exceed current efficiency levels through the use of high efficiency compressors and fan motors, thicker insulation, and other measures.

Commercial ice machines often have high compressor duty cycles compared to other commercial foodservice appliances. An average duty cycle of approximately 75% is assumed for ice machines[[10]](#endnote-10).

The industry standard for energy use and performance of commercial ice machines is AHRI Standard 810. Table 7 lists the cost effectiveness of Super Energy Efficient ice machines, based on the individual machines operating at 85% of their rated maximum capacity.

Table below details energy savings for each measure code, and can be verified on Food Service Technology Center life cycle cost calculator[[11]](#endnote-11).

Table - Super Energy Efficient Commercial Air-Cooled Ice Machine Cost Effectiveness Example

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Performance** | **F200** | **F201** | **F202** | **F203** | **F204** |
| Ice Harvest Rate (IHR) (lbs. per 24 hrs.) | 101-300 | 301-500 | 501-1,000 | 1,001-1,500 | > 1,500 |
| Ice Machine Type\* | SCU | IMH | IMH | RCU | RCU |
| Ice Machine Size (Ice Harvest Rate (lbs./day) | 200 | 400 | 750 | 1,250 | 1,750 |
| Daily Ice Usage at 75% duty cycle (lbs./day) a | 150 | 300 | 562.5 | 937.5 | 1312.5 |
| Baseline Model (Energy Usage (kWh/100 lbs.) b | 9.80 | 6.82 | 6.07 | 5.10 | 5.10 |
| Energy Efficient Model (15% less) Energy Usage (kWh/100 lbs.)c | 8.33 | 5.80 | 5.16 | 4.34 | 4.34 |
| Baseline Model Daily Energy Consumption (kWh/day) | 14.70 | 20.46 | 34.14 | 47.81 | 66.94 |
| Energy Efficient Model Daily Energy Consumption (kWh/day) | 12.50 | 17.40 | 29.03 | 40.69 | 56.96 |
| Baseline Model Annual Energy Consumption (kWh/yr.) | 5366 | 7468 | 12462 | 17452 | 24432 |
| Energy Efficient Model Annual Energy Consumption (kWh/yr.) | 4561 | 6351 | 10594 | 14851 | 20791 |
| **Estimated Annual Energy Savings (kWh/yr.)** | **805** | **1117** | **1868** | **2601** | **3641** |

\* Ice Machine Type: SCU – Self Contained Unit; IMH – Ice Making Head; RCU – Remote Condensing Unit

a Ice Machine report – Emerging Technologies (ET) Energy Efficient Commercial Foodservice – Scaled Field Placement

b Title 20 Energy Efficiency Requirements for Air-Cooled Commercial Ice Machines

c 15% less energy usage than the Energy Efficient model listed as the baseline model (Super Energy Efficient)

**Daily Energy Consumption and Definitions:**

**Baseline Daily Energy Consumption Example (F202):**

**Hand calculation may generate slightly different number due to rounding to significant digits.**

**Super-Efficient Ice Machine Energy Consumption Example (F202):**

**Annual Energy Savings Example F202):**

## 2.2. Demand Reduction Estimation Methodologies

* There is a demand reduction potential with this measure.
* This measure does not include HVAC interactive effects savings.

An ice harvest cycle for a commercial ice machine usually ranges between 10 and 20 minutes, and ice machines usually run several consecutive harvest cycles. The probability of the ice machine operating at full input rate during peak periods is very high as outlined in “Emerging Technologies (ET) Energy-Efficient Commercial Foodservice-Scaled Field Placement”.

To calculate ice machine Demand KW, the daily average kW is divided by the duty cycle:

**Baseline Model Demand kW Example (F202):**

**Super-Efficient Ice Machine Demand kW Example (F202):**

Applying a Coincidence Factor of 0.9 per the DEER methodology[[12]](#endnote-12), yields a claimable demand savings of 0.256kW. Table below summarizes the Demand Savings for the various sizes of Super Energy Efficient ice machines.

Table - Super Energy Efficient Commercial Air-Cooled Ice Machine Demand Savings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ice Harvest Rate (IHR) (lbs. per 24 hrs.) | 101-300 | 301-500 | 500-1000 | 1001-1500 | > 1500 |
| Average IHR Used in  Energy Calculations (lbs./day) | 200 | 400 | 750 | 1,250 | 1,750 |
| Baseline Model  Average Demand (kW) | 0.817 | 1.137 | 1.897 | 2.656 | 3.719 |
| Energy Efficient Model  Average Demand (kW) | 0.694 | 0.967 | 1.613 | 2.260 | 3.165 |
| Estimated Demand Reduction (kW) | 0.123 | 0.170 | 0.284 | 0.396 | 0.554 |
| **Claimable Demand Savings with CF (kW)\*** | **0.110** | **0.153** | **0.256** | **0.356** | **0.499** |

**\***Applying a Coincidence Factor (CF) of 0.9 per the DEER methodology

## 

## 2.3. Gas Energy Savings Estimation Methodologies

There are no gas energy savings associated with this measures.

# *Section 3 Load Shapes*

Load Shapes are an important part of the life-cycle cost analysis of any energy efficiency program portfolio. The net benefits associated with a measure are based on the amount of energy saved and the avoided cost per unit of energy saved. For electricity, the avoided cost varies hourly over an entire year. Thus, the net benefits calculation for a measure requires both the total annual energy savings (kWh) of the measure and the distribution of that savings over the year. The distribution of savings over the year is represented by the measure’s load shape. The measure’s load shape indicates what fraction of annual energy savings occurs in each time period of the year. An hourly load shape indicates what fraction of annual savings occurs for each hour of the year. A Time-of-Use (TOU) load shape indicates what fraction occurs within five or six broad time-of-use periods, typically defined by a specific utility rate tariff. Formally, a load shape is a set of fractions summing to unity, one fraction for each hour or for each TOU period. Multiplying the measure load shape with the hourly avoided cost stream determines the average avoided cost per kWh for use in the life cycle cost analysis that determines a measure’s Total Resource Cost (TRC) benefit.

## 3.1 Base Case Load Shapes

The base case load shape would be expected to follow a typical nonresidential foodservice end use load shape.

Commercial ice machine load shapes differ among food service facilities (quick service, casual dining, hotels, college, schools, hospitals, etc.) depending on daily hours of operation, serving periods, day-of-week, and facility location (city downtown, suburban mall, access to interstate highways, etc.). Consequently, applicable average TOU and hourly load shapes for ice machines are unavailable. Commercial ice machines will generally consume more energy during operating hours, when the demand for ice is the greatest.

## 3.2 Measure Load Shapes

For purposes of the net benefits estimates in the E3 calculator, what is required is the load shape that ideally represents the *difference* between the base equipment and the installed energy efficiency measure. This *difference* load profile is what is called the Measure Load Shape and would be the preferred load shape for use in the net benefits calculations.

The measure load shape for this measure is determined by the E3 calculator based on the applicable nonresidential market sector and the foodservice end-use.

The electric demand profile for the high-efficiency ice machines is expected to be the same as the Base Case. The profile will vary as explained in Section 3.1. The Measure Load Shape for the high-efficiency ice machine will use less energy and have a slightly lower demand profile.

# Section 4 Base Case & Measure Costs

Super Energy Efficient ice machines typically have a higher list price than standard efficiency ice machines. Models that meet this requirement incorporate better insulation, reducing heat gain, and more efficient components such as electrically commutated (EC) evaporator fan motors and high-efficiency compressors.

* The full list of cost data can be found in Appendix A
* Base case and Measure case costs are averaged and found in Table 9.

## 4.1 Base Case(s) Costs

The Base Case costs include only the equipment. Super Energy Efficient ice machines require no additional labor or maintenance compared to base case ice machines. Since this measure is applicable for ROB and NC installations, the installation and maintenance costs are expected to be the same for the customer. The estimated equipment cost is based on recent list cost data for ice machines and applying an industry-standard 50% discount to the manufacturer published list prices.

## 4.2 Measure Case Costs

The Measure costs include only the equipment, as explained in Section 4.1. The estimated equipment cost is based on recent list cost data and applying an industry-standard 50% discount to the manufacturer published list prices (see Appendix A).

Equipment prices for these work papers were compiled from a number of sources including, Autoquotes [[13]](#endnote-13), equipment sales reps and manufacturer sources. Since equipment pricing in food service is closely held information and prices vary widely according to buying volume and other factors, we cannot list the sources for prices specifically.

## 4.3 Incremental & Full Measure Costs

Incremental measure costs (IMC) are used in this analysis.

Table - Equipment Incremental Cost Data for Super Energy Efficient Ice Machines

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Measure Code** | **Ice Harvest Rate (IHR) (lbs. per 24 hrs.)** | **Super Energy Efficient Average List Price**\* | **Baseline Average List Price** | **Average Incremental Measure List Price** | **Super Energy Efficient Average Cost\*\*** | **Baseline Average Cost\*\*** | **Incremental Measure Cost (IMC)** |
| F200 | 101-300 | $5,549 | $4,927 | $622 | $2,775 | $2,464 | **$311** |
| F201 | 301-500 | $5,346 | $4,814 | $532 | $2,673 | $2,407 | **$266** |
| F202 | 501-1,000 | $9,121 | $8,624 | $497 | $4,561 | $4,312 | **$249** |
| F203 | 1,001-1,500 | $9,375 | $8,197 | $1,178 | $4,688 | $4,099 | **$589** |
| F204 | > 1,500 | $16,259 | $14,382 | $1,877 | $8,130 | $7,191 | **$939** |

\* Costs taken from published 2011-2012 manufacturers’ list prices

\*\* Estimated purchase price based on a typical 50% discount from the published list prices

# Appendix A

**Equipment Cost Data for Ice Machines**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Make Energy Efficient** | **Model** | **Ice Harvest Rate (lb/24h)** | **List Price** | **Cost($)\*** |
| Super Efficient | Hoshizaki | KM-201BAH | 165 | $4,300 | $2,150 |
| Super Efficient | Hoshizaki | F-330BAH | 250 | $6,400 | $3,200 |
| Super Efficient | Manitowoc | SN-12 | 253 | $6,996 | $3,498 |
| Super Efficient | Scotsman | C0322SA-1# | 255 | $4,616 | $2,308 |
| Super Efficient | Scotsman | C0330MA-1# | 280 | $4,459 | $2,230 |
| Super Efficient | ICE-O-Matic | EF250A38S | 319 | $7,745 | $3,873 |
| Super Efficient | Manitowoc | ID-0522A-161 | 325 | $4,846 | $2,423 |
| Super Efficient | Hoshizaki | F-330BAH-C | 330 | $6,400 | $3,200 |
| Super Efficient | Manitowoc | IY-0454A-261 | 335 | $4,777 | $2,389 |
| Super Efficient | Scotsman | N0622A-1A | 500 | $8,308 | $4,154 |
| Super Efficient | ICE-O-Matic | MFI0800A | 579 | $7,600 | $3,800 |
| Super Efficient | Manitowoc | IY-1004A-261 | 745 | $8,968 | $4,484 |
| Super Efficient | Scotsman | N0922A-32A | 765 | $10,309 | $5,155 |
| Super Efficient | Manitowoc | ID-1202A-261 | 870 | $9,607 | $4,804 |
| Super Efficient | Scotsman | F1222R-32A | 1050 | $9,774 | $4,887 |
| Super Efficient | Hoshizaki | KM-1301SRH3 | 1197 | $9,250 | $4,625 |
| Super Efficient | Hoshizaki | KM-1301SRH | 1222 | $9,100 | $4,550 |
| Super Efficient | Manitowoc | SY-1874C | 1550 | $11,752 | $5,876 |
| Super Efficient | Scotsman | NME1854RS-32# | 1575 | $19,541 | $9,771 |
| Super Efficient | Hoshizaki | KM-1900SRH | 1616 | $12,200 | $6,100 |
| Super Efficient | Hoshizaki | KMH-2000SRH | 1694 | $14,200 | $7,100 |
| Super Efficient | Manitowoc | SD-3074C | 2420 | $23,604 | $11,802 |
| Baseline | Manitowoc | QD-0212A | 147 | $4,488 | $2,244 |
| Baseline | Scotsman | CU3030MA-1# | 217 | $5,188 | $2,594 |
| Baseline | Hoshizaki | KM-260BAH | 200 | $5,000 | $2,500 |
| Baseline | ICE-O-Matic | ICEU300FA | 228 | $4,995 | $2,498 |
| Baseline | Cornelius | CCU0300AF1 | 228 | $4,964 | $2,482 |
| Baseline | Hoshizaki | KMD-410MAH | 324 | $4,550 | $2,275 |
| Baseline | Manitowoc | IY-0454A-161 | 335 | $4,777 | $2,389 |
| Baseline | ICE-O-Matic | ICE0406FA | 358 | $4,700 | $2,350 |
| Baseline | Cornelius | CCM0430AH1 | 368 | $4,895 | $2,448 |
| Baseline | Scotsman | CB0530SA-1C | 380 | $5,150 | $2,575 |
| Baseline | Scotsman | C0830MA-3# | 724 | $7,723 | $3,862 |
| Baseline | Cornelius | CCM1030AH2 | 793 | $8,604 | $4,302 |
| Baseline | ICE-O-Matic | ICE1007HA | 800 | $8,560 | $4,280 |
| Baseline | Manitowoc | IY-1204A-261 | 930 | $9,607 | $4,804 |
| Baseline | Manitowoc | SD-1402A | 1160 | $8,618 | $4,309 |
| Baseline | Hoshizaki | KM-1300SRH/URC-21F | 1163 | $8,012 | $4,006 |
| Baseline | Hoshizaki | KMS-1401MLJ | 1221 | $7,960 | $3,980 |
| Baseline | Hoshizaki | KM-1800SRH | 1651 | $10,889 | $5,444 |
| Baseline | Hoshizaki | KMS-2000MLH | 1706 | $9,850 | $4,925 |
| Baseline | Scotsman | C2148SR-32A | 1849 | $13,186 | $6,593 |
| Baseline | Manitowoc | SY-3074C | 2420 | $23,604 | $11,802 |

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2. *Energy Savings Potential for Commercial Refrigeration Equipment*, pp. 39-49; by Arthur D. Little (ADL) 1996. [↑](#endnote-ref-2)
3. Codes and Standards Enhancement Initiative For PY2004: Title 20 Standards Development Analysis of Standards Options For Commercial Packaged Refrigerators, Freezers, Refrigerator-Freezers and Ice Makers; Page 15 “Table 8. Energy and Demand Savings from More California Efficiency Standards on Reach-Ins and Ice-Makers”

   [http://www.energy.ca.gov/appliances/archive/2003rulemaking/documents/case\_studies/CASE\_Packaged\_Refrigeration.pdf](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.energy.ca.gov_appliances_archive_2003rulemaking_documents_case-5Fstudies_CASE-5FPackaged-5FRefrigeration.pdf&d=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=J0XEr0c9dYcqhvG7d6rvhlTmUF7smH-uiEc47RYqjrE&s=8qS7dfv3Wvs--zt0bV75rSQ4e496NI2sH730eIsecGo&e=) [↑](#endnote-ref-3)
4. The table “Measure Application Type” in the Measure Catalog can be found on the Database for Energy-Efficient Resources (DEER) website, <http://www.deeresources.com/> [↑](#endnote-ref-4)
5. 2015 California Energy Commission (CEC) Title 20 Appliance Efficiency Regulations, CEC 400-2015-021, <http://www.energy.ca.gov/2015publications/CEC-400-2015-021/CEC-400-2015-021.pdf> [↑](#endnote-ref-5)
6. DEER 2016, EUL values from READI tool;

   <http://www.deeresources.com/index.php/deer-versions/readi> [↑](#endnote-ref-6)
7. DEER 2016, NTGR values from READI tool;

   <http://www.deeresources.com/index.php/deer-versions/readi> [↑](#endnote-ref-7)
8. Automatic commercial icemakers manufactured and distributed in commerce, as defined by [42 U.S.C. 6291(16)](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.gpo.gov_fdsys_pkg_USCODE-2D2010-2Dtitle42_html_USCODE-2D2010-2Dtitle42-2Dchap77-2DsubchapIII-2DpartA-2Dsec6291.htm&d=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=kbvQp7ddvxCFGFI9sAEZDY-57F6aAIqCjUk3mYSFEp0&s=tvyzf4mTHbuDYF9v1CDEHVC1Wc1CpCOxcHy1LqI0sjg&e=), must meet the energy conservation standards specified in the Code of Federal Regulations at [10 CFR 431.136](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.ecfr.gov_cgi-2Dbin_text-2Didx-3FSID-3Da25116a0785a0c488243d01bddb84f90-26mc-3Dtrue-26node-3Dse10.3.431-5F1136-26rgn-3Ddiv8&d=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=kbvQp7ddvxCFGFI9sAEZDY-57F6aAIqCjUk3mYSFEp0&s=Q3aky3FhAL4eUxr8o3DbDXk7HnBkuujEsLvFAi-up7o&e=)

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9. American Council for an Energy-Efficient Economy (ACEEE), 2002; *Packaged Commercial Refrigeration Equipment: A Briefing Report for Program Planners and Implementers.* [↑](#endnote-ref-9)
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13. AutoQuotes electronic catalog for foodservice equipment and supplies <http://www.aqnet.com/> . [↑](#endnote-ref-13)