

Commercial Ice Machines

Program Guide



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Table of Contents

- 1 Background 5
- 2 Purpose 5
- 3 Equipment Description 5
- 4 Product Use and Lifetimes 7
- 5 Specifications and Test Methods..... 7
- 6 Product Availability and Market Penetration 8
- 7 Incremental Retail Price..... 10
- 8 Energy Savings.....17
- 9 Program Design Tips 18
- 10 Additional Resources 19

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1 Background

CEE launched the [CEESM Commercial Kitchens Initiative](#) (Initiative) in 2005 to provide clear and credible definitions in the marketplace as to what constitutes highly efficient energy and water performance in commercial cooking, refrigeration, and sanitation equipment and to help streamline the selection of products through a targeted market strategy. Since 2005, CEE has developed a suite of specifications to identify energy and water efficient commercial kitchen equipment, tracked availability of commercial kitchen efficiency programs, and documented the approaches and impacts of existing programs. CEE members can find more information on the current Initiative direction and activities on the [CEE](#) web site. Additional resources and specifications have been developed by the [ENERGY STAR[®]](#) program, including specifications and guidance for operators and efficiency program administrators.

2 Purpose

The purpose of this document is to provide CEE member energy efficiency program administrators information to streamline the development and maintenance of voluntary energy efficiency programs for commercial ice machines. This document supports the Initiative objectives and CEE Ice Machines Specification by providing guidance to CEE member energy efficiency program administrators on topics that may inform program design and development. This guide includes information on the following topics: equipment description, product use and lifetimes, specifications and test methods, product availability, price differential, energy savings, program design tips, and additional resources. This document was created by CEE staff based on research and analysis conducted by the CEE Commercial Kitchens Committee during development of the CEE ice machines specification. This guide does not include program design recommendations or CEE program or policy positions.

3 Equipment Description

Commercial ice machines produce ice for commercial facilities such as hotels, restaurants, hospitals, schools, offices, and grocery stores. Ice machines are typically equipped with insulated storage bins or ice dispensers, self-contained or remote refrigeration systems, and water management systems. Ice storage bins are usually sized to manage peak demand for ice. The refrigeration system turns water into ice by circulating a refrigerant through various components. The water management system performs three functions—water supply, circulation, and purge.

Ice machine refrigeration systems may be air-cooled or water-cooled. Air-cooled ice machines rely on motor driven fans or centrifugal blowers to move air through the condenser to remove heat from the refrigerant. Water-cooled machines run water through the condenser to remove heat from the refrigerant.

Commercial ice machines can make three different types of ice¹:

1. **Cube ice**, which is made in a batch production process with alternate freezing and harvesting periods; cube ice is about 95% to 99% hard² and most typically used for beverage applications
2. **Nugget ice**, which is made in a continuous production process that continually freezes and harvests ice at the same time in a barrel-shaped evaporator; an auger inside the evaporator scrapes the ice off the sides of the evaporator and then the machine compresses the ice flakes into nuggets; nugget ice is usually 80% to 95% hard and most typically used for beverage applications
3. **Flake ice**, which is made in a continuous production process that continually freezes and harvests ice at the same time in a barrel-shaped evaporator; an auger inside the evaporator scrapes the ice off the sides of the evaporator creating flakes of ice; flake ice is usually 60% to 80% hard and most typically used for applications other than beverages.

Within each cooling and ice type, commercial ice machines are available using five different technology platforms³:

1. **Ice making heads** have the ice making mechanism and condensing unit in a single package, but have a separate ice storage bin.
2. **Self-contained units** have the ice making mechanism and condensing unit in a single package with an integrated ice storage bin.
3. **Remote condensing units with remote compressor** have the ice making mechanism and condensing unit, including compressor, in separate sections.
4. **Remote condensing units without remote compressor** have the ice making mechanism and condenser, not including compressor, in separate sections.
5. **Remote low side units** have the ice making mechanism and condensing unit, including compressor, in separate sections, but the condensing unit and compressor are part of an existing refrigeration system instead of dedicated refrigeration system. Note that remote low side units are currently outside the scope of CEE and ENERGY STAR[®] specifications.

¹ These definitions are based on a combination of the definitions in CEE and ENERGY STAR performance specifications, CEE analysis of product model data provided by manufacturers containing information on ice hardness, and market research on typical ice applications by CEE staff.

² Ice hardness refers to the percentage of zero degree ice within the entire piece of ice in question. For example, an ice hardness factor of 95% indicates that the ice is made of up 95% zero degree ice and 5% water.

³ These definitions are based on the definitions in CEE and ENERGY STAR performance specifications.

The differences among technology platforms are summarized in Table 1 below.

Table 1. Ice Machine Technology Platform Characteristics

Technology Platform	Ice Making Head	Self-Contained	Remote Condensing with Remote Compressor	Remote Condensing without Remote Compressor	Remote Low Side Units
Abbreviation	IMH	SC	RCU	RCU	RCU
Storage Bin	Separate	Integrated	Separate	Separate	Separate
Condenser	Integrated	Integrated	Remote	Remote	Remote
Compressor	Integrated	Integrated	Remote	Integrated	Remote
Dedicated, Model Specific Condensing Unit	Yes	Yes	Yes	Yes	No

4 Product Use and Lifetimes

Ice machines are typically operated 24 hours per day, 365 days per year.⁴ Commercial ice machines typically last about seven to ten years.⁵ The ENERGY STAR savings calculator estimates the equipment lifetime of ice machines at eight years.

5 Specifications and Test Methods

CEE and ENERGY STAR have both developed efficiency specifications for commercial ice machines. The CEE specification as of July 1, 2011 has two tiers, Tier 1 and Tier 2, with different energy and water consumption requirements. A snapshot of the relationship between specifications, scope of each, and performance requirements over respective baselines is outlined in Table 2 below.

⁴ Ice machines, like refrigerators, are generally never turned off per se, but instead cycle on and off automatically based on need. Therefore, while the machine is always on, it is not always making ice. Duty cycle estimates range from 34% to 75% based on *Packaged Commercial Refrigeration Equipment: A Briefing Paper for Program Planners and Implementers* by Steve Nadel of ACEEE (2002), *Energy Savings Potential for Commercial Refrigeration Equipment* by Arthur D. Little (1996) and the ENERGY STAR energy savings calculator.

⁵ Arthur D. Little, *Energy Savings Potential for Commercial Refrigeration Equipment*, 1996.

Table 2. Ice Machine Specifications Snapshot

	Current ENERGY STAR (Version 1)	Current CEE Tier 1	Current CEE Tier 2
Equivalency to Other Specifications	Current CEE Tier 1, air-cooled machines only; pre-July 1, 2011 Tier 2, air-cooled machines only	Pre-July 1, 2011 Tier 2; current ENERGY STAR (Version 1) for air-cooled machines	None
Scope: Cooling Types	Air only	Air and water	Air and water
Scope: Ice Types	Cube only	Cube only	Cube, nugget, and flake
Energy Performance Criteria	7–10% below US federal minimum standards , depending on technology platform and size	7–10% below US federal minimum standards , depending on technology platform and size	10% below average performance of machines in 2010
Potable Water Performance Criteria	25 to 35 gallons per 100 lb of ice, depending on technology platform and size	25 to 35 gallons per 100 lb of ice, depending on technology platform and size	20 to 30 gallons per 100 lb of ice, depending on size

Links to specifications, qualifying products lists, and the test method are provided below.

- CEE Specification <<http://www.cee1.org/com/com-kit/files/IceSpecification.pdf>>
- CEE Qualified Product List <http://www.cee1.org/com/com-kit/files/icemachines_prod_list.xls>
- ENERGY STAR Specification and Qualified Product List <http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CIM>
- Air-Conditioning, Heating and Refrigeration Institute Test Method 810-2007, *Performance Rating of Automatic Commercial Ice Makers* <http://www.ahrinet.org/App_Content/ahri/files/standards%20pdfs/AHRI%20standards%20pdfs/AHRI%20Standard%20810%20-%202007%20with%20Addendum%201.pdf>

6 Product Availability and Market Penetration

As of April 2010, there were eight manufacturers making ice machine products. These were: Cornelius, Follet, Hoshizaki, Ice-o-matic, Kold-Draft, Manitowoc, Scotsman, and Vogt Ice.

As of June 2011, product model availability for the CEE Tier 1 levels was 19–68% (see Table 3 below for details by specification category). According to EPA ENERGY STAR shipment data, market penetration as of 2009 at the CEE Tier 1 levels was 42%.

Table 3. Product Model Availability for CEE Tier 1 as of June 2011

Cooling Type	Technology Platform	Harvest Rate (lb/day)	Total Models		
			Meeting Federal Standards	# Models Meeting CEE Tier 1	% Model Qualification CEE Tier 1
Air	Ice Making Head	<450	98	57	58%
		>=450	138	50	36%
	Remote Condensing	<1000	119	57	48%
		>=1000	102	34	33%
	Remote Condensing and Compressor	<934	34	12	35%
		>=934	38	26	68%
	Self-Contained	<175	34	20	59%
		>=175	21	14	67%
Water	Ice Making Head	<500	94	49	52%
		>=500 and < 1436	108	26	24%
		>=1436	67	13	19%
	Self-Contained	<200	21	11	52%
		>=200	15	6	40%

Product availability for CEE Tier 2 as of June 2011 ranged from 0–22% depending on specification category (see Table 4 below). One to four manufacturers provide products in each product category. Information on market penetration of CEE Tier 2 qualifying machines is not available.

Table 4. Product Availability at the CEE Tier 2 Performance Levels as of June 2011

Harvest Rate (lb/day)	Total Models	Qualifying Models	% Qualifying Models	Total Manufacturers	Qualifying Manufacturers	% Qualifying Manufacturers
Air-Cooled, Cube and Nugget						
<175	38	8	21%	7	2	29%
175-449	143	31	22%	8	4	50%
450-999	248	2	1%	6	1	17%
1000+	199	11	6%	6	3	50%
Air-Cooled, Flake						
<1000	23	3	13%	4	3	75%
1000+	6	0	0%	2	0	0%
Water-Cooled, Cube and Nugget						
<175	10	1	10%	5	1	20%
175-449	107	8	7%	6	1	17%
450-999	95	3	3%	6	1	17%
1000+	113	6	5%	6	1	17%
Water-Cooled, Flake						
<1000	6	0	0%	2	0	0%
1000+	4	0	0%	2	0	0%

7 Incremental Retail Price

Analysis of the retail list prices on models currently available indicates that there is not a retail price premium for more energy and water efficient units (see charts 1 through 12 below). Nugget machines do appear to have a retail price premium over cube type machines.

CEE collected the list price data shown in the charts below from AutoQuotes™⁶ in July 2010. It includes list price information on 656 models made by seven manufacturers. This represents 83% of the models included in the data set used to develop the CEE specification. This pricing information is not necessarily indicative of any incremental manufacturing cost, or lack thereof, to achieve higher efficiency, only the current pricing strategies of the manufacturers at the point in time when it was collected. End users typically pay approximately 40% of the list price for ice machines, however, this can vary based on manufacturer, distributor, and dealer pricing strategies.⁷

⁶ AutoQuotes is a foodservice equipment database that provides up-to-date list pricing information for the vast majority of foodservice equipment available in the market.

⁷ This assumption is based on anecdotal information from industry partners and CEE members.

Chart 3. Air-Cooled Cube and Nugget Machines by List Price, Harvest Rate ≥ 450 lb/day and < 1000 lb/day.

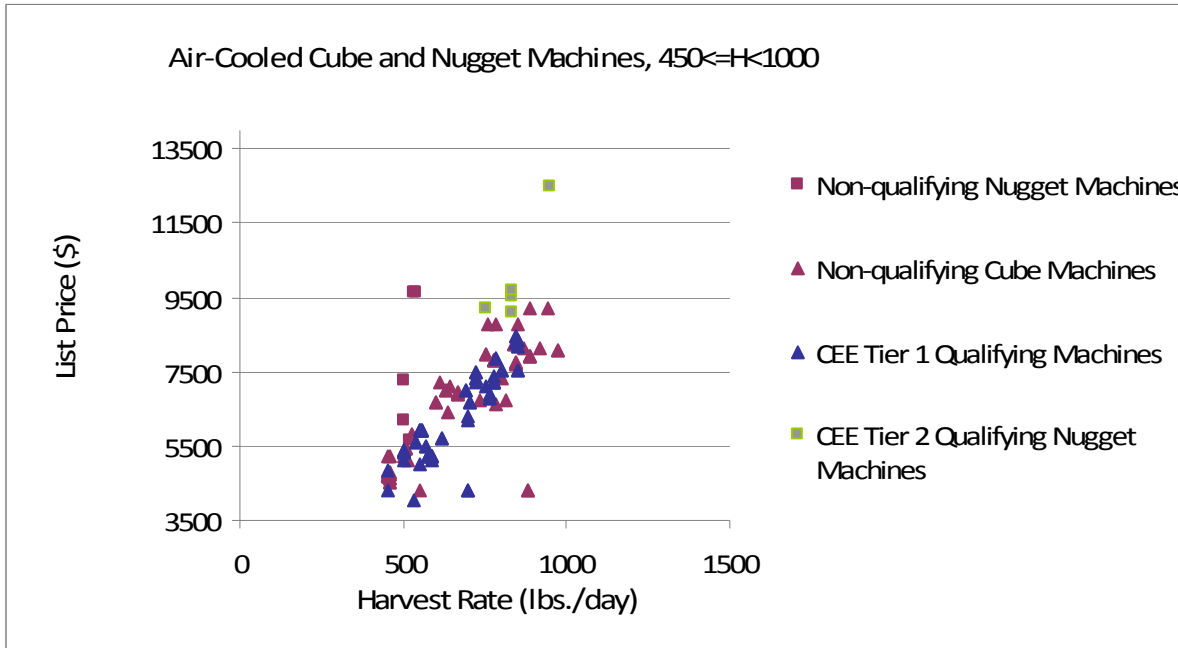


Chart 4. Air-Cooled Cube and Nugget Machines by List Price, Harvest Rate ≥ 1000 lb/day.

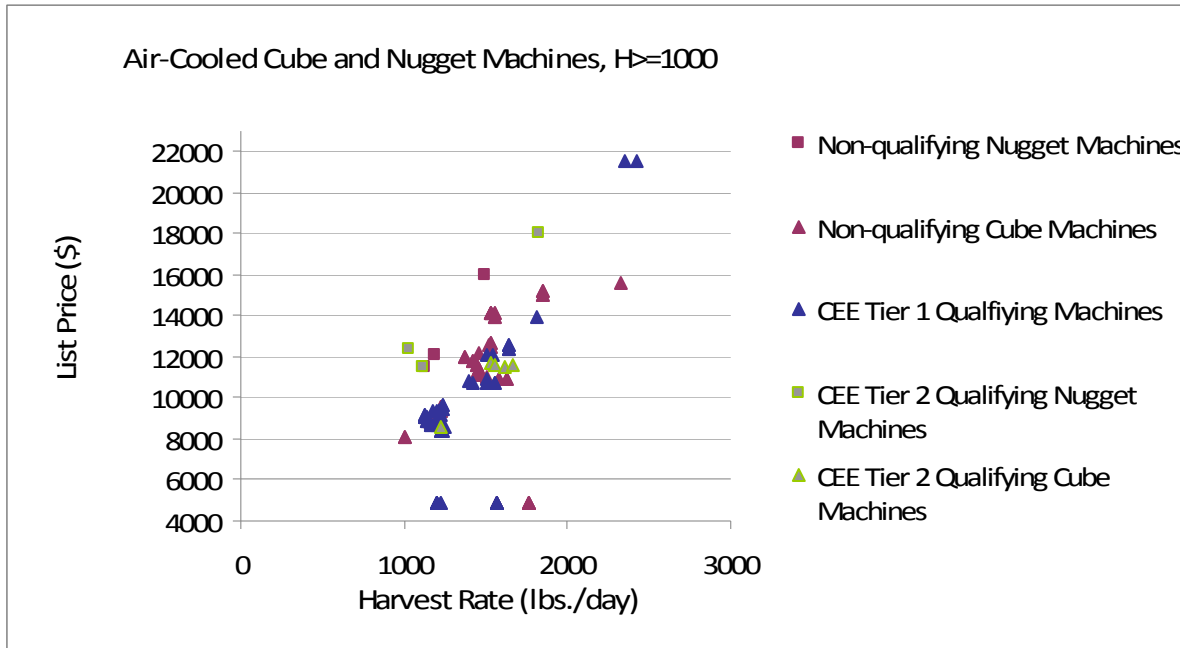


Chart 5. Air-Cooled Flake Type Machines by List Price, Harvest Rate < 1000 lb/day.

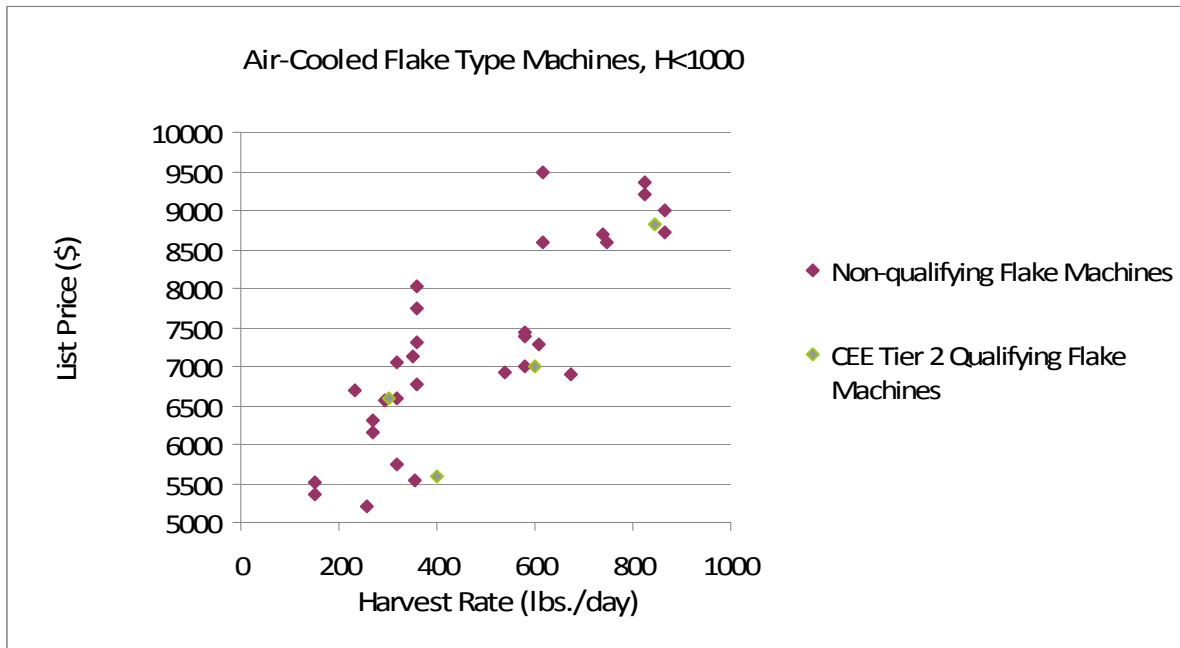


Chart 6. Air-Cooled Flake Type Machines by List Price, Harvest Rate \geq 1000 lb/day.

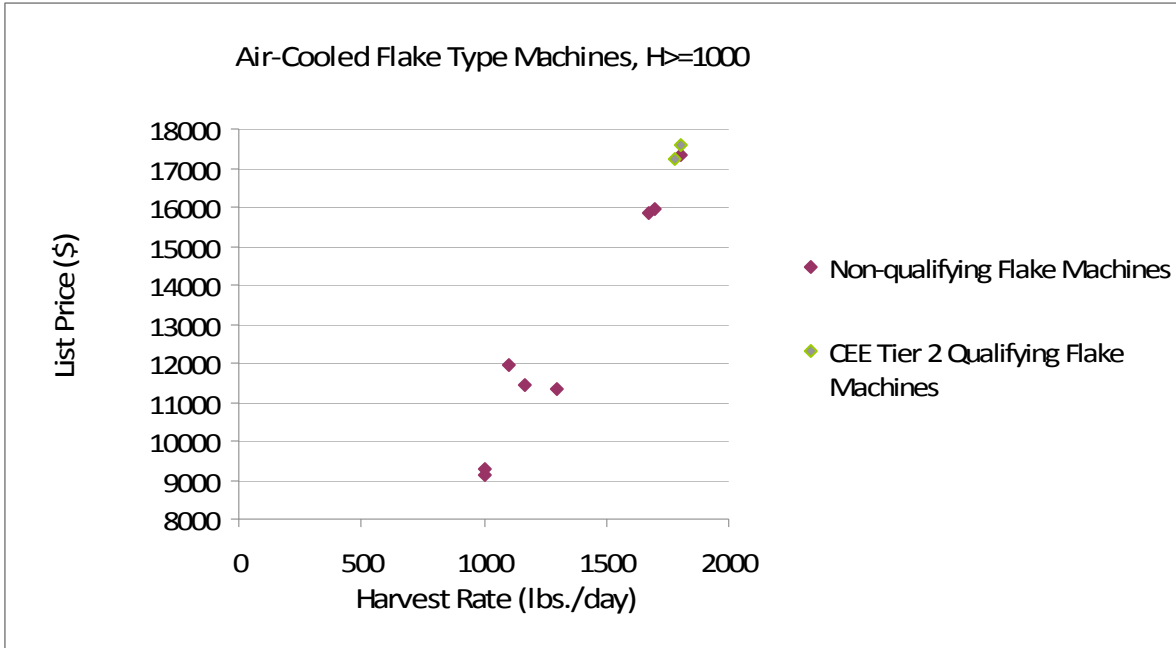


Chart 7. Water-Cooled Cube and Nugget Machines by List Price, Harvest Rate less than 175 lb/day

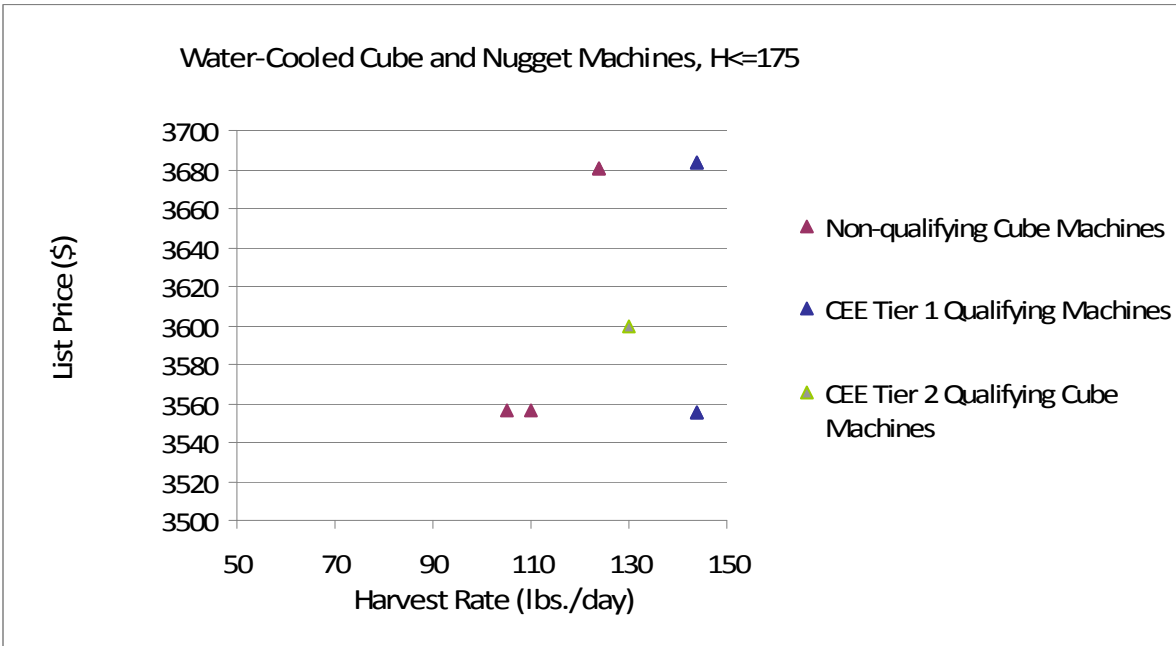


Chart 10. Water-Cooled Cube and Nugget Machines by List Price, Harvest Rate ≥ 1000 lb/day

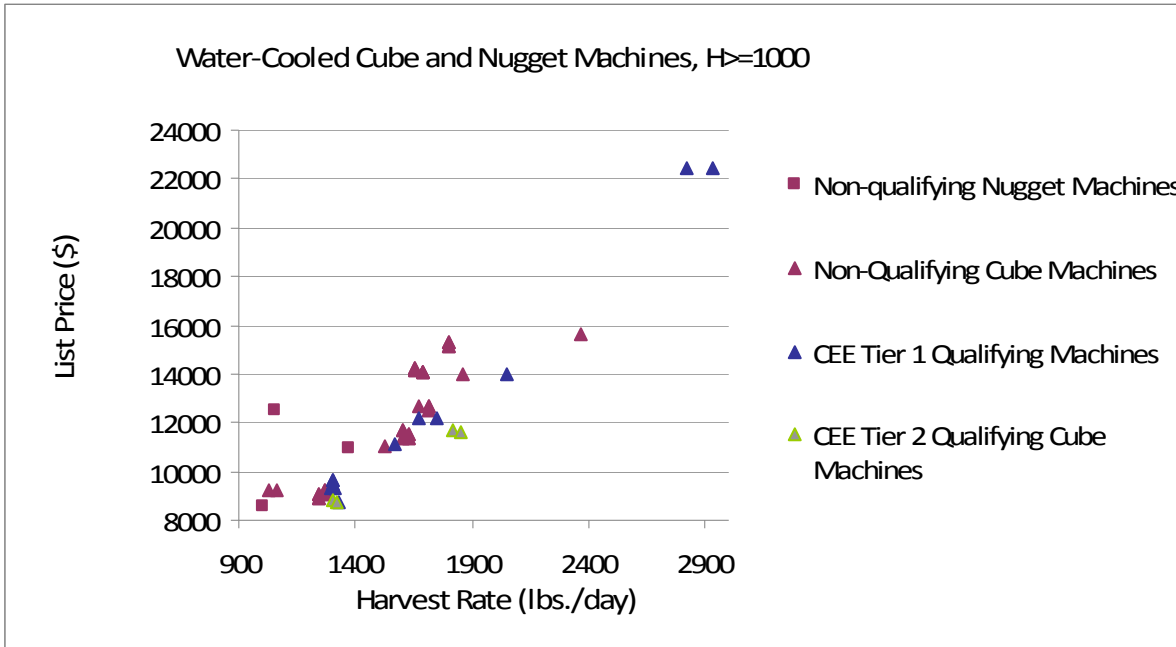


Chart 11. Water-Cooled Flake Type Machines by List Price, Harvest Rate < 1000 lb/day

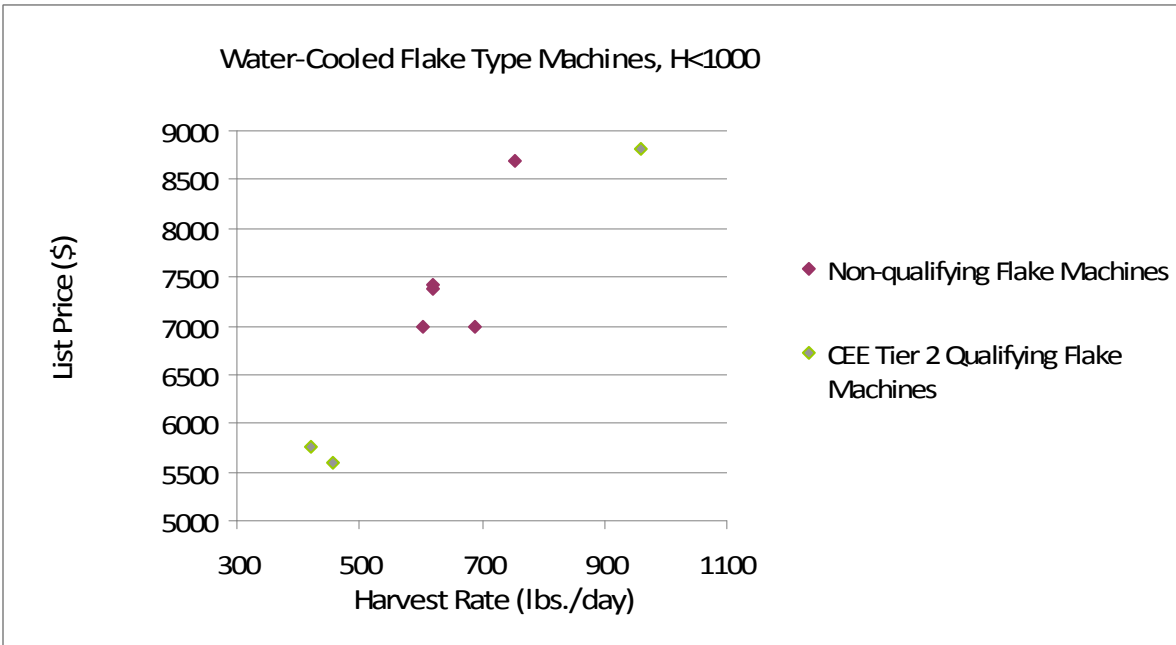
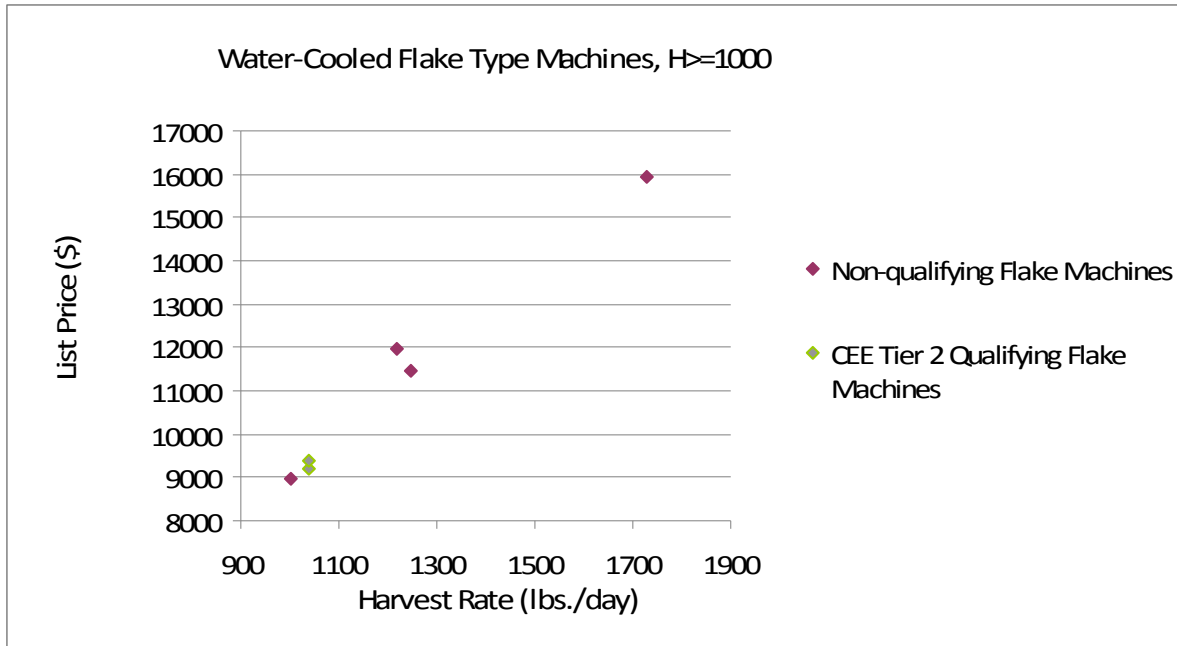


Chart 12. Water-Cooled Flake Type Machines by List Price, Harvest Rate ≥ 1000 lb/day



8 Energy Savings

The CEE Tier 1 performance levels deliver energy savings of approximately 7 to 10% beyond the current US **federal minimum** energy efficiency **standards** for ice machines depending on technology platform and size category. Federal energy efficiency standards for ice machines are currently under revision. More information on the federal standard revision process can be found at

http://www1.eere.energy.gov/buildings/appliance_standards/commercial/automatic_ice_making_equipment.html.

The CEE Tier 2 performance levels deliver energy savings of approximately 10% compared to the **average performance** of machines at the time the specification was developed. Average machine performance is based on the average linear trend line for all machines in each specification category. Because the current federal standard and CEE Tier 1 specification are technology specific in their approach and do not cover flake and nugget machines, the energy savings for CEE Tier 2 compared to these two baseline points ranges significantly (10–59% below the US federal standard and 0–16% below CEE Tier 1). Table 5 below summarizes energy savings by product type and size category for the CEE Tier 2 levels.

Table 5. Energy Savings Associated with CEE Tier 2 Specification

Harvest Rate (lb/day)	Maximum Energy Consumption (kWh/year)			Energy Savings (kWh/year)		Energy Savings (%)	
	Federal Standard	CEE Tier 1	CEE Tier 2	CEE Tier 2 v. Federal Standard	CEE Tier 2 v. CEE Tier 1	CEE Tier 2 v. Federal Standard	CEE Tier 2 v. CEE Tier 1
Air-Cooled, Cube and Nugget							
50-174	1314-2500	1219-2315	1022-2023	292-447	95-184	19-22%	8%
175-449	2237-4195	2014-3784	2015-3409	222-786	223-410	10-19%	11%
450-999	4202-8447	3778-7586	3403-6274	798-2172	424-861	19-26%	11%
1000+	7446-22338	6774-20323	6278-17082	1168-5256	672-2015	16-24%	10%
Air-Cooled, Flake							
50-999	1314-8447	n/a	462-4672	724-3774	n/a	22-65%	n/a
1000+	7446-22238	n/a	4672-14016	2774-8322	n/a	37%	n/a
Water-Cooled, Cube and Nugget							
50-174	832-2056	774-1910	774-1628	58-429	0-283	7-21%	0-15%
175-449	1747-3494	1575-3160	1537-2829	210-665	38-330	12-19%	2-10%
450-999	3341-6536	3075-6025	2763-5252	578-1284	312-773	17-20%	10-12%
1000+	6541-17520	6029-16118	5110-13578	1430-3942	920-2540	22-23%	15-16%
Water-Cooled, Flake							
50-999	832-6536	n/a	344-4524	488-2012	n/a	44-59%	n/a
1000+	6541-17520	n/a	4526-13578	2014-3942	n/a	23-31%	n/a

9 Program Design Tips

Federal minimum standards in the US and Canada, ENERGY STAR, and CEE Tier 1 performance levels remain technology platform specific as of June 2011. This means that there are different performance levels for each technology platform: self-contained machines, ice making heads, and remote condensing units. Each technology platform is broken up into slightly different size categories. CEE Tier 2 is technology platform neutral with similar, but not equal, size categories with regard to federal standards, ENERGY STAR, and CEE Tier 1. If federal standards, ENERGY STAR, or CEE Tier 1 are used as a baseline from which to calculate savings for CEE Tier 2, it may be helpful for program administrators to develop several additional machine categories behind the scenes to calculate savings for technology platforms and sizes in which the baseline categories do not map cleanly to the CEE Tier 2 categories.

10 Additional Resources

Additional resources that may be useful are:

- ENERGY STAR ice machines page
<http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CIM>. ENERGY STAR includes specifications, qualified product lists, case studies, and general savings information about commercial ice machines. Links to other commercial foodservice equipment categories are also provided.
- Pacific Gas and Electric Food Service Technology Center (FSTC) Life Cycle Cost Calculators
<<http://www.fishnick.com/saveenergy/tools/calculators/>>. On this web page, the FSTC provides a life cycle cost calculator for ice machines. Calculators for other commercial kitchen equipment categories are also provided.