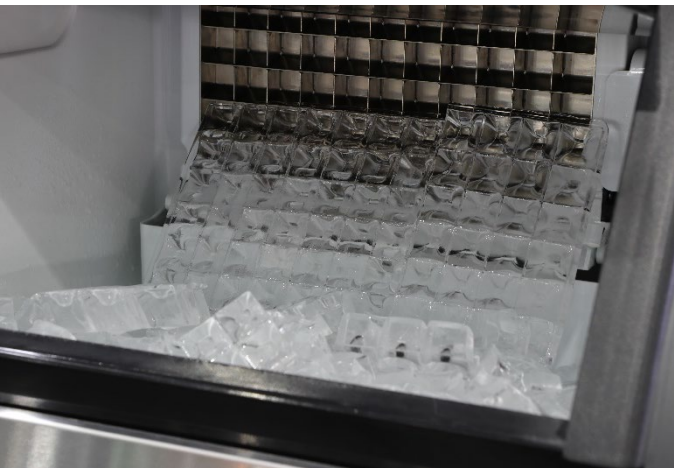
WaterSense at Work

Commercial Kitchen Equipment

4.2 Commercial Ice Makers



Best Management Practices for Commercial and Institutional Facilities

EPA WaterSense

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WaterSense® is a voluntary partnership program sponsored by the U.S. Environmental Protection Agency (EPA) that seeks to protect the nation's water supply by transforming the market for water-efficient products, services, and practices.

WaterSense at Work is a compilation of water efficiency best management practices intended to help commercial and institutional facility owners and managers from multiple sectors understand and better manage their water use. It provides guidance to help establish an effective facility water management program and identify projects and practices that can reduce facility water use.

An overview of the sections in *WaterSense at Work* is below. This document, covering water efficiency for commercial ice makers, is part of **Section 4: Commercial Kitchen Equipment**. The complete library of best management practices is available at www.epa.gov/watersense/best-management-practices. WaterSense has also developed worksheets to assist with water management planning and case studies that highlight successful water efficiency efforts of building owners and facility managers throughout the country, available at www.epa.gov/watersense/commercial-buildings.

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This document is one section from *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* (EPA-832-F-23-003). Other sections can be downloaded from www.epa.gov/watersense/best-management-practices. Sections will be reviewed and periodically updated to reflect new information. The work was supported under contract 68HERC20D0026 with Eastern Research Group, Inc. (ERG).

Overview

Commercial ice makers use refrigeration units to freeze water into ice for cooling or preserving food and other items. Ice makers are a mainstay in various settings, including restaurants, commercial kitchens, fast food establishments, convenience stores, grocery stores, schools, hotels, hospitals, and laboratories. Ice makers typically use water for two purposes: cooling the refrigeration unit and making ice. There are ways to address the efficiency of both aspects.

Cooling the Refrigeration Unit

The ice-making process generates a significant amount of heat, and therefore requires the use of either air or water cooling to remove this waste heat from the ice maker's refrigeration unit.

Types of Ice Makers

There are three primary types of ice makers:

1. **Ice-making head units** can be either water- or air-cooled. These units include the ice-making mechanism and the condenser unit in a single package, and the ice storage bins are sold separately.
2. **Self-contained units** can be either water- or air-cooled. These units contain the ice-making mechanism, condenser unit, and a built-in storage bin in an integral cabinet. These units are typically small, undercounter units that produce a smaller volume of ice.
3. **Remote condensing units** are air-cooled and contain the ice-making mechanism and the condenser unit in a separate section. They transfer the heat generated by the ice-making process outside the building.

Air-cooled ice makers are more water-efficient since they eliminate water used to cool the refrigeration unit altogether. Air-cooled ice makers use motor-driven fans or centrifugal blowers to move air through the refrigeration unit to remove heat. Air-cooled models are suitable for most commercial settings. They typically require at least 6 inches (15 centimeters) of clearance around the air intake and discharge areas and are best suited for areas where the surrounding air temperature is 80°F (27°C) or less. They also work more efficiently in clean environments without a lot of dust or grease.

Water-cooled ice machines should only be used if a facility's environment necessitates it, such as where ambient air temperatures are expected to be consistently greater than 80°F (27°C) or there is not enough clearance to allow air-cooled units to adequately cool. In the most basic configuration, water-cooled ice makers pass water through the machine once to cool it, and then send the single-pass water down the drain. Water-cooled systems can use less water by recirculating the cooling water through a chiller or a cooling tower to

lower the temperature, returning the water to the machine for reuse (i.e., closed loop recirculation).

Ice Production

Regardless of how the machine is cooled, all ice makers use water to produce ice. The amount of water used for the ice-making process depends on the facility's incoming water quality and on the desired end quality of the ice. If a machine were 100 percent water-efficient, it would use approximately 12 gallons (45 liters) of water to produce 100 pounds (45 kilograms [kg]) of ice.[1]

There are two basic types of ice makers that produce three types of ice. Batch-type ice makers create cube ice and continuous-type ice makers produce nugget and flake ice.

Cube ice is clear and relatively free of imperfections, because cube ice makers use a repeated freezing and partial thawing process. The ice cubes are washed as they freeze, so any sediment or minerals that may accumulate on the forming cubes are removed. Rinse water is typically dumped as the ice maker operates. This method produces more crystalline ice with fewer air bubbles, but the process uses more water. In general, the higher the quality of ice, the more water is needed for the ice-making process. Cube ice makers are the most common type of ice maker on the market, and cube ice is often used for beverages.

Nugget and flake ice isn't rinsed, so it can be produced continuously. Flake ice is often used in food retail outlets, such as grocery seafood displays or salad bars, since there is less concern for the clarity of the ice used. Nugget ice is softer and often used for beverages and in healthcare settings.

Flake ice used in a grocery seafood display

Water and Energy Use of Ice Makers

Not including cooling water used by water-cooled ice makers, producing 100 pounds (45 kg) of ice requires from 12 to over 50 gallons (45 to over 189 liters) of water, depending on the amount of rinsing water used and the quality of ice being made.[2]

[1] Koeller, John (Koeller and Company) and H.W. (Bill) Hoffman & Associates, LLC. June 2008. *Evaluation of Potential Best Management Practices—Commercial Ice Machines*. Prepared for the California Urban Water Conservation Council. https://calwep.org/wp-content/uploads/2021/03/Commercial-Ice-Makers-PBMP-2008.pdf.
[2] *Ibid*.

In total, including the ice-making and cooling processes, water-cooled ice makers with single-pass cooling consume between 100 and 300 gallons (379 and 1,136 liters) of water per 100 pounds (45 kg) of ice produced, while air-cooled ice makers consume less than 50 gallons (189 liters) of water per 100 pounds (45 kg) of ice produced.[3]

Self-contained ice maker

The U.S. Department of Energy (DOE) sets energy and water use standards for ice makers in the Code of Federal Regulations.[4] These standards establish a maximum water consumption for the ice machine's water-cooled condenser unit. The standards do not address water used to make ice. To recognize energy- and water-efficient ice makers, ENERGY STAR® qualifies batch-type and continuous-type air-cooled ice makers that meet more stringent energy use and potable water use criteria (measured in gallons per 100 pounds of ice produced). ENERGY STAR certified batch-type ice makers are, on average, 10 percent more energy-efficient and 20 percent more water-efficient than standard air-cooled models.[5]

In addition, to further decrease the impact of commercial ice makers on the environment, ENERGY STAR differentiates models that have lower global warming potential (GWP) refrigerant, which means the product will have a lower impact on the environment if the refrigerant is inadvertently released. ENERGY STAR's Product Finder allows consumers to filter for those models that contain refrigerants with a lower GWP.[6]

The Consortium for Energy Efficiency (CEE) also has a specification to promote high-efficiency air- and water-cooled commercial ice makers. The advanced tier specification recognizes ice makers that are even more efficient than ENERGY STAR's maximum requirements. Unlike ENERGY STAR, CEE qualifies water-cooled units; the specification requires that water-cooled machines be installed using a closed-loop water cooling

[3] New York City Environmental Protection. *Restaurant Managers Guide to Water Efficiency*. Page 4. www.nyc.gov/assets/dep/downloads/pdf/water/drinking-water/restaurant-managers-guide-to-water-efficiency.pdf.
[4] Office of the Federal Register. Code of Federal Regulations, Title 10 Energy, Chapter II, Subchapter D, Part 431, Subpart H, Energy Conservation Standards, § 431.136. www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-431/subpart-H/subject-group-ECFR055e135ff65e6f5/section-431.136.
[5] ENERGY STAR. Commercial Ice Makers. www.energystar.gov/products/commercial_ice_makers.
[6] ENERGY STAR. Product Finder. ENERGY STAR Certified Commercial Ice Machines. www.energystar.gov/productfinder/product/certified-commercial-ice-machines/.

system or a system that uses a remote evaporative condenser (i.e., a cooling tower). Single-pass water cooling is not permitted.[7]

A summary of the water efficiency requirements of the ENERGY STAR and CEE specifications is shown in Table 1.

Table 1. Water Efficiency Criteria for ENERGY STAR and CEE Specifications

	Potable Water Use (gallons per 100 pounds [45 kg] of ice)[8]			
Equipment Type	ENERGY STAR and CEE Tier 1 (Air-Cooled)	CEE Tier 1 (Water-Cooled)	CEE Advanced Tier (Air-Cooled)	CEE Advanced Tier (Water-Cooled)
Batch-Type Ice Making Head	≤ 20.0	≤ 20.0	≤ 15.0	≤ 19.0
Batch-Type Remote Condensing Unit	≤ 20.0	N/A	≤ 15.0	N/A
Batch-Type Self-Contained Unit	≤ 25.0	≤ 20.0	≤ 15.0	≤ 19.0
Continuous-Type Ice Making Head	≤ 15.0	≤ 20.0	≤ 15.0	≤ 19.0
Continuous-Type Remote Condensing Unit	≤ 15.0	N/A	≤ 15.0	N/A
Continuous-Type Self-Contained Unit	≤ 15.0	≤ 20.0	≤ 15.0	≤ 19.0

Operation, Maintenance, and User Education

For optimum ice maker efficiency, consider the following:

- Periodically clean the ice maker to remove lime and scale build-up and sanitize it to kill bacteria and fungi.
    - For self-cleaning/sanitizing machines, run the self-cleaning option.
    - For units without a self-cleaning mode, shut down the machine, empty the bin of ice, add cleaning/sanitizing solution to the machine, switch it to cleaning mode, then switch it to ice production mode when finished. For health and safety purposes, create and discard several batches of ice to remove residual cleaning solution.

[7] Consortium for Energy Efficiency (CEE). *CEE High Efficiency Specification for Automatic Commercial Ice Machines*. https://cee1.org/program-resources/.
[8] To convert gallons per 100 pounds of ice to liters per 100 kg of ice, multiply by a factor of 8.35.

- Keep the ice maker's coils clean and air intakes clear of dust to ensure the heat exchange process is running as efficiently as possible.
- Keep the lid closed to keep cool air inside the ice maker and maintain the appropriate temperature.
- Install a timer to shift ice production to nighttime or off-peak hours. This will cut down on the facility's peak energy demand.

Ice maker lid left open when not in use, letting cool air out of machine

- Keeping in mind local water quality and site requirements, work with the manufacturer to ensure that the ice maker's rinse cycle is set to the lowest possible frequency that still provides sufficient ice quality. If available, use the ice maker's ability to initiate rinse cycles based on sensor readings of minerals.
- Follow the manufacturer-provided use and care instructions for the specific model ice maker used at the facility.
- Periodically check for leaks, monitor the condition of components, and provide repairs if necessary.
- Train users to report leaking or otherwise improperly operating ice makers to the appropriate personnel.

Retrofit Options

If the ice maker is cooled using single-pass water, and it is not feasible to replace it with an air-cooled ENERGY STAR model as discussed below, modify it to operate on a closed loop that recirculates the cooling water through a cooling tower or heat exchanger. See *WaterSense at Work Section 6.2 Single-Pass Cooling* at www.epa.gov/watersense/best-management-practices for more information about modifying or replacing equipment that uses single-pass cooling. If eliminating single-pass cooling is not feasible, consider reusing the cooling water for another application. See *WaterSense at Work Section 8: Onsite Alternative Water Sources* at www.epa.gov/watersense/best-management-practices for more information.

Replacement Options

When replacing an ice maker or installing a new one, ensure that the new model is sized appropriately to fit the facility's needs. If the machine produces too large of a yield, water will be wasted by producing unnecessary ice. Also choose an ice maker that is appropriate for the quality of ice needed. Producing ice of higher quality than required will use water

unnecessarily. If feasible, consider selecting flake or nugget ice makers, which use less water and energy than cube ice makers.

Most importantly, look for ENERGY STAR certified, air-cooled models by using ENERGY STAR's Product Finder at www.energystar.gov/productfinder/product/certified-commercial-ice-machines/. To further reduce the environmental impact of the ice maker, select ENERGY STAR certified ice makers that have lower GWP using the filter on ENERGY STAR's Product Finder. In addition to looking for ENERGY STAR certified models, consider air-cooled ice makers that meet the Advanced Tier efficiency specifications outlined by CEE.[9]

If installing a water-cooled unit is necessary, look for models that meet CEE's Advanced Tier requirements. Only select water-cooled models when they are able to be connected to a recirculating cooling water loop.

Savings Potential

A facility will realize varying levels of water savings, depending on whether it is replacing an existing air-cooled ice maker or retrofitting or replacing an existing water-cooled model.

Replacing a Standard Air-Cooled Ice Maker With an ENERGY STAR Certified Model

ENERGY STAR certified ice makers are, on average, 10 percent more energy-efficient and 20 percent more water-efficient than standard air-cooled models.[10] Total savings depend on the type of machine selected.

Use ENERGY STAR's Commercial Food Service (CFS) Equipment Calculator at www.energystar.gov/partner-resources/energy-star-training-center/commercial-food-service to estimate facility-specific water, energy, and cost savings for replacing an existing air-cooled ice maker with an ENERGY STAR certified model.

Retrofitting or Replacing a Water-Cooled Ice Maker With an Air-Cooled Model

A facility will see the most water savings from replacing a water-cooled ice maker with an ENERGY STAR certified, air-cooled model or retrofitting a water-cooled ice maker by using an existing building chilled water loop instead of single-pass cooling for the condenser. To estimate facility-specific water savings and payback, facility managers can also use the following information.

[9] CEE, *op. cit.*
[10] ENERGY STAR, Commercial Ice Makers, *op. cit.*

Current Water Use

To estimate the current water use from a water-cooled ice maker, identify the following information and use Equation 1:

- The ice maker's harvest rate, or how many pounds of ice it produces per day.
- The ice maker's maximum water use rate. DOE sets requirements for the maximum condenser water use (in gallons per 100 pounds of ice produced) for water-cooled ice makers in the *Code of Federal Regulations*.[11] These maximums don't account for the water use needed to make the ice, so that should be added when determining the ice maker's water use rate. Alternatively, search the make and model of the ice maker in the Air Conditioning, Heating, and Refrigeration Institute's (AHRI's) Directory of Certified Product Performance database at https://ahridirectory.org/search/31, which provides the potable water use rate for producing ice and condenser water rate for many commercial ice makers.
- Days of facility operation per year.

Equation 1. Water Use of Ice Maker (gallons or liters per year)

= Harvest Rate x Water Use Rate x Days of Facility Operation

Where:

- Harvest Rate: Pounds or kilograms of ice per day
- Water Use Rate: Gallons or liters of water needed for the condenser and to produce ice per 100 pounds (45 kilograms) of ice
- Days of Facility Operation: Days per year

Water Use After Retrofit

If the facility intends to retrofit a water-cooled ice maker by utilizing an existing building chilled water loop for cooling instead of single-pass cooling water, use Equation 1 to calculate the water use of the retrofit, since here will now be no condenser.

Water Use After Replacement

To estimate the water use of a replacement air-cooled model, use Equation 1, substituting the harvest rate (if it will change) and the new water use per 100 pounds (45 kilograms) of

[11] Office of the Federal Register, *op. cit.*

ice. ENERGY STAR provides different water use maximums for certified air-cooled models depending on the machine type and the harvest rate.[12]

Water Savings

To calculate water savings that can be achieved from retrofitting or replacing an existing water-cooled ice maker, identify the following information and use Equation 2:

- Current water use as calculated using Equation 1.
- Water use after retrofit or replacement as calculated using Equation 1.

Equation 2. Water Savings From Ice Maker Retrofit or Replacement (gallons or liters per year)

= Current Water Use of Ice Maker – Water Use of Ice Maker After Retrofit or Replacement

Where:

- Current Water Use of Ice Maker: Gallons or liters per year
- Water Use of Ice Maker After Replacement: Gallons or liters per year

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Payback

To calculate the simple payback from the water savings associated with retrofitting or replacing a water-cooled ice maker, consider the equipment and installation cost of the replacement air-cooled model or the project cost of using the building chilled water loop, the water savings as calculated in Equation 2, and the facility-specific cost of water and wastewater.

The facility should also consider the energy impact of replacing old equipment. ENERGY STAR certified ice makers are approximately 10 percent more energy-efficient than standard air-cooled models.[13] California Energy Wise has energy cost calculators at www.caenergywise.com/calculators/ that can be used to calculate the energy savings potential from replacing many types of commercial kitchen equipment, including commercial ice makers. This energy savings will further reduce the payback period and increase replacement cost-effectiveness.

[12] ENERGY STAR. Commercial Ice Maker Key Product Criteria. www.energystar.gov/products/commercial_food_service_equipment/commercial_ice_makers/key_product_criteria.
[13] ENERGY STAR, Commercial Ice Makers, *op. cit.*

Rebates and other incentives can also impact the cost savings and payback of replacing old equipment. Local water utilities may offer rebates to offset the cost of a new, energy- and/or water-efficient ice machine. More information about potential rebates can be found at www.energystar.gov/rebate-finder.

Additional Resources

Air Conditioning, Heating, and Refrigeration Institute. Directory of Certified Product Performance, Automatic Commercial Ice-Makers and Ice-Storage Bins. https://ahridirectory.org/search/31.

Alliance for Water Efficiency. March 2017. *Commercial Kitchens Water Use Efficiency and Best Practices Guide*. https://allianceforwaterefficiency.org/resource/commercial-kitchens-guide/.

California Energy Wise. Energy Cost Calculators. www.caenergywise.com/calculators/.

Consortium for Energy Efficiency. Initiatives, Summaries and Qualified Product Listings. https://cee1.org/program-resources/.

Cornelius, Adam, Angelo Karas, et. al. (Fisher-Nickel, Inc.). March 2013. *Emerging Technologies Energy-Efficient Commercial Foodservice—Scaled Field Placement*. Prepared for Pacific Gas and Electric Company. www.etcc-ca.com/sites/default/files/reports/ET12PGE3152_FS%20Technology,%20Load%20Shifting%20Ice%20Machines_Phase%20B_Final%20Report%20_04.04.13.PDF.

ENERGY STAR. Commercial Ice Makers. www.energystar.gov/products/commercial_ice_makers.

ENERGY STAR. Commercial Kitchen Equipment Tools, Materials and Resources. www.energystar.gov/partner-resources/energy-star-training-center/commercial-food-service.

ENERGY STAR. 2017-2018. ENERGY STAR *Guide for Cafes, Restaurants, and Institutional Kitchens*. www.energystar.gov/sites/default/files/asset/document/ES%20Restaurant%20Guide%202017-2018%20v16.pdf.

ENERGY STAR. Product Finder. ENERGY STAR Certified Commercial Ice Machines. www.energystar.gov/productfinder/product/certified-commercial-ice-machines/.

Koeller, John (Koeller and Company) and H.W. (Bill) Hoffman & Associates, LLC. June 2008. *Evaluation of Potential Best Management Practices—Commercial Ice Machines*. Prepared for the California Urban Water Conservation Council. https://calwep.org/wp-content/uploads/2021/03/Commercial-Ice-Makers-PBMP-2008.pdf.

New York City Environmental Protection. *Restaurant Managers Guide to Water Efficiency*. www.nyc.gov/assets/dep/downloads/pdf/water/drinking-water/restaurant-managers-guide-to-water-efficiency.pdf.

Office of the Federal Register. *Code of Federal Regulations*, Title 10 Energy, Chapter II, Subchapter D, Part 431, Subpart H, Energy Conservation Standards, § 431.136. www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-431/subpart-H/subject-group-ECFR055e135ff65e6f5/section-431.136.

U.S. Department of Energy Federal Energy Management Program. Best Management Practice #11: Commercial Kitchen Equipment. www.energy.gov/femp/best-management-practice-11-commercial-kitchen-equipment.

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