2.4.3 ENERGY STAR® Electric Deck Ovens

TRM Measure ID: NR-FS-DO

Market Sector: Commercial

Measure Category: Appliances

Applicable Building Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

A commercial electric deck oven is an appliance that cooks food products within a heated chamber. The food product can be placed directly on the floor of the chamber during cooking and energy is delivered to the food product by convective, conductive, or radiant heat transfer. The chamber can be heated by electric forced convection, radiation, or quartz tubes. The top and bottom heat of the oven can be controlled independently.

Deck ovens are available in various sizes measured by the surface area of the oven cavity floor. Sizes range from approximately 1,000 sq. in. to 2,200 sq. ft. Deck ovens are typically stackable to allow for multiple ovens on a single floor space.

Deck oven performance is determined by applying the American Society for Testing and Materials (ASTM) Standard Test Method for Performance of Deck Ovens F1965-99, the industry standard for quantifying the efficiency and performance of commercial deck ovens.

The following metrics define deck oven energy performance:

- *Cooking energy efficiency:* Quantity of energy imparted to the specific food product, expressed as a percentage of energy consumed by the deck oven during the cooking event.
- *Idle energy rate:* The deck oven's rate of energy consumption (Btu/h or kW), when emptied, required to maintain its cavity temperature at the specified thermostat set point.
- *Production capacity:* The maximum rate (lb/hr) at which a deck oven can bring the specified food product to a specified cooked condition.

Eligibility Criteria

This measure only applies to deck ovens installed in retrofit applications. New construction applications are ineligible unless pre-approved by the evaluator. Eligible units must meet the criteria described in the high-efficiency condition.

The following products are excluded from the eligibility criteria:

- Gas or dual-fuel heat source deck ovens
- Used or rebuilt deck ovens
- Replacement of gas deck ovens

Eligible building types include any nonresidential application.

Baseline Condition

There are currently no federal minimum standards for commercial electric deck ovens. Therefore, the baseline condition is defined as an electric deck oven that does not meet program criteria. Consequently, the baseline condition for existing models was established through lab-based performance tests conducted by the Southern California Edison Foodservice Technology Center (SCE FTC) and Pacific Gas & Electric Food Service Technology Center (PG&E FSTC).

Generally, new construction is ineligible to claim savings under this measure. However, utilities may work with the EM&V team to determine the baseline standard for new construction applications, if applicable.

High-Efficiency Condition

Eligible equipment must meet the energy efficiency and idle rate requirement from Table 150.

Table 150. Deck Ovens—Measure Case Specification

Operation	Criteria
Cooking energy efficiency	≥ 60%
Idle energy rate	≤ 1.3 kW

In absence of lab testing, eligible products must be included on the current California Energy Wise Foodservice Qualified Product Listing (QPL).[315]

[315] CA Energy Wise Foodservice QPL. https://caenergywise.com/instant-rebates/qpl/. For assistance with qualifying new models, reach out to the California Foodservice Instant Rebates program. https://caenergywise.com/instant-rebates/#contact-us.

Energy and Demand Savings Methodology

Savings Calculations and Input Variables

The annual electric unit energy savings is calculated as the difference between the baseline and measure case unit energy consumption (UEC). The daily electric UEC (baseline or measure case) is equal to the sum of the energy required for cooking, preheat, and idle modes of oven operation. The calculations below represent the measure case condition.

The inputs for calculating the yearly UEC of a commercial electric deck oven are specified below. The days of operation are calculated from on-site monitored data and survey responses, as shown in the referenced source. The commercial cooktop hours of operation day were derived from field data from 14 test sites, assuming one boil cycle per hour. The field monitoring sample included quick- and full-service restaurants, hospitality locations, and cafeterias.

The deemed values are calculated by using the following equations:

$$Energy\ Savings\ [\Delta kWh]\ =\ kWh_{base} - kWh_{measure}$$

Equation 108

$$kWh_{base} = kWh_{ph,base} + kWh_{cook,base} + kWh_{idle,base}$$

Equation 109

$$kWh_{measure} = kWh_{ph,measure} + kWh_{cook,measure} + kWh_{idle,measure}$$

Equation 110

Annual kWh_{ph}, kWh_{cook}, and kWh_{idle} are each calculated the same for both the baseline and measure cases, except they require their respective input assumptions relative to preheat, cooking, and idle operation as seen in Table 151. Peak demand savings are calculated by Equation 114 using their respective input assumptions from Table 151.

$$kWh_{ph} = N_{ph} \times E_{ph} \times \mathrm{t_{days}}$$

Equation 111

$$kWh_{cook} = \left(\frac{W_{food} \times E_{food}}{\eta_{cook}}\right) \times \mathrm{t_{days}}$$

Equation 112

$$kWh_{idle} = E_{idle} \times \left(\mathrm{t_{on}} - \frac{W_{food}}{\mathrm{PC}} - (N_{ph} \times t_{ph}\right) \times \mathrm{t_{days}}$$

Equation 113

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh}{\mathrm{t}_{on} \times \mathrm{t_{days}}} \times CF$$

Equation 114

Where:

$kWh_{cook,base}$ = *Cooking energy, baseline, annual [kWh]*

$kWh_{cook,measure}$ = *Cooking energy, measure case, annual [kWh]*

$kWh_{idle,base}$ = *Idle energy, baseline, annual [kWh]*

$kWh_{idle,measure}$ = *Idle energy, measure case, annual [kWh]*

$kWh_{ph,base}$ = *Preheat energy, baseline, annual [kWh]*

$kWh_{ph,measure}$ = *Preheat energy, measure case, annual [kWh]*

η_{cook} = *Cooking energy efficiency*

E_{ph} = *Measured preheat energy [kWh]*

E_{food} = *Cooking energy efficiency*

E_{idle} = *Measured idle energy rate [kW]*

W_{food} = *Estimated pounds of food cooked per day [lbs]*

PC = *Measured production capacity [lbs/hr]*

N_{ph} = *Estimated number of preheats per day [#]*

t_{ph} = *Estimated preheat time [hr]*

DOH = *Equipment daily operating hours [hr/day]*

AOD = *Facility annual operating days [days/year]*

CF = *Peak coincidence factor*

Table 151. Deck Ovens—Calculation Inputs[316]

Parameter	Baseline	High-efficiency
η_{cook}	40%	60%
E_{ph} (kWh)	6.5	3.0
E_{food} (kWh/lb)	0.0732	
E_{idle} (kW)	1.9	1.3
W_{food} (lb/day)	200	
PC (lb/hr)	60	

[316] Input assumptions were developed through lab-based equipment performance tests conducted by the SCE FTC and PG&E FSTC.

Parameter	Baseline	High-efficiency
N_{ph}		1
t_{ph} (hr)		0.5
CF[317]		0.90

Table 152. Deck Ovens—Operating Schedule Assumptions[318]

Building type	DOH	AOD
Education: K-12	6	180
Education: College and university	10	260
All other	12	355

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in the following table are based on the input assumptions from Table 151.

Table 153. Deck Ovens—Annual Energy and Peak Demand Savings

Building type	Energy savings [kWh]	Peak demand savings [kW]
Education: K-12	3,060	2.55
Education: College and university	5,044	1.75
All other	7,313	1.55

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) Remote Ex-Ante Database Interface (READI) tool for EUL IDs Cook-ElecCombOven and Cook-ElecConvOven.[319]

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[317] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

[318] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

[319] DEER READI. http://www.deeresources.com/index.php/readi.

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly.

- Building type
- Oven quantity
- Manufacturer and model number
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility equipment AOD and DOH (if available)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 154. Deck Ovens—Revision History

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 origin.

2.4.4 ENERGY STAR® Dishwashers Measure Overview

TRM Measure ID: NR-FS-DW

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Building Types: All commercial kitchens and multifamily buildings

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of ENERGY STAR commercial dishwashers. On average, commercial dishwashers that have earned ENERGY STAR certification are 25 percent more energy-efficient and 25 percent more water-efficient than standard models. The energy savings associated with ENERGY STAR commercial dishwashers are primarily due to reduced water use and reduced need to heat water. A commercial kitchen may have external booster water heaters, or booster water heaters may be internal to specific equipment. Both primary and booster water heaters may be either gas or electric; therefore, dishwasher programs need to ensure the savings calculations used are appropriate for the water heating equipment installed at the participating customer's facility. The energy and demand savings are determined on a per-dishwasher basis.

Eligibility Criteria

Eligible units must be compliant with the current ENERGY STAR specification and fall under one of the following categories.[320, 321] These categories are described in Table 155:

- Under counter dishwasher
- Stationary rack, single tank, door type dishwasher
- Single tank conveyor dishwasher
- Multiple tank conveyor dishwasher
- Pot, pan, and utensil

[320] ENERGY STAR Program Requirements Product Specifications for Commercial Dishwashers. Eligibility Criteria v3.0. https://www.energystar.gov/products/commercial_dishwashers/partners.

[321] ENERGY STAR Qualified Product Listing. https://www.energystar.gov/productfinder/product/certified-commercial-dishwashers/results.

Eligible building types include any nonresidential application.[322]

Dishwashers intended for use in residential or laboratory applications are not eligible for ENERGY STAR under this product specification. Residential equipment is eligible for installation in commercial applications. In this scenario, refer to the residential savings methodology described in Volume 2. Steam, gas, and other non-electric models also do not qualify.

Additionally, though single- and multiple-tank flight-type conveyor dishwashing machines (where the dishes are loaded directly on the conveyor rather than transported within a rack—also referred to as a rackless conveyor) are eligible as per the version 3.0 specification, they are considered ineligible for this measure, since default values are not available for flight-type dishwashers in the ENERGY STAR Commercial Kitchen Equipment Calculator.

Table 155. Dishwashers—ENERGY STAR Equipment Type Descriptions

Equipment type	Equipment description
Under-counter dishwasher	A machine with an overall height of 38" or less, in which a rack of dishes remains stationary within the machine while being subjected to sequential wash and rinse sprays and is designed to be installed under food preparation workspaces. Under-counter dishwashers can be either chemical or hot-water sanitizing, with an internal booster heater for the latter. For purposes of this specification, only those machines designed for wash cycles of ten minutes or less can qualify for ENERGY STAR.
Stationary-rack, single-tank, door-type dishwasher	A machine in which a rack of dishes remains stationary within the machine while subjected to sequential wash and rinse sprays. This definition also applies to machines in which the rack revolves on an axis during the wash and rinse cycles. Subcategories of stationary door type machines include single- and multiple-wash tank, double rack, pot, pan and utensil washers, chemical dump type, and hooded wash compartment ("hood type"). Stationary-rack, single-tank, door-type models are covered by this specification and can be either chemical or hot-water sanitizing, with an internal or external booster heater for the latter.
Single-tank conveyor dishwasher	A washing machine that employs a conveyor or similar mechanism to carry dishes through a series of wash and rinse sprays within the machine. Specifically, a single-tank conveyor machine has a tank for wash water followed by a final sanitizing rinse and does not have a pumped rinse tank. This type of machine may include a pre-washing section before the washing section. Single-tank conveyor dishwashers can either be chemical or hot-water sanitizing, with an internal or external booster heater for the latter.
Multiple-tank conveyor dishwasher	A conveyor-type machine that has one or more tanks for wash water and one or more tanks for pumped rinse water, followed by a final sanitizing rinse. This type of machine may include one or more pre-washing sections before the washing section. Multiple-tank conveyor dishwashers can be either chemical or hot-water sanitizing, with an internal or external hot-water-booster heater for the latter.
Pot, pan, and utensil	A stationary-rack, door-type machine designed to clean and sanitize pots, pans, and kitchen utensils.

[322] CEE Commercial Kitchens Initiative's overview of the Food Service Industry: https://forum.cee1.org/system/files/library/4203/CEE_CommKit_InitiativeDescription_Aug2021.pdf

Baseline Condition

Baseline equipment is either a low-temperature[323] or high-temperature[324] machine as defined by Table 155, which is not used in a residential or laboratory setting. For low-temperature units, the DHW is assumed to be electrically heated. For high-temperature units, the DHW can either be heated by electric or natural gas methods. For units heated with natural gas, the unit shall have an electric booster heater attached to it.

High-Efficiency Condition

Qualifying equipment must be compliant with the current ENERGY STAR v3.0 specification, effective July 27, 2021. High-temperature equipment sanitizes using hot water and requires a booster heater. Low-temperature equipment uses chemical sanitization and does not require a booster heater. Qualified products must be less than or equal to the maximum idle energy rate and water consumption requirements from Table 156.

Table 156. Dishwashers—ENERGY STAR Specification[325]

Machine type	Low-temperature efficiency requirements		High-temperature efficiency requirements	
	Idle energy rate (kW)	Water consumption (gal/rack)	Idle energy rate (kW)	Water consumption (gal/rack)
Under counter (UC)	≤ 0.25	≤ 1.19	≤ 0.30	≤ 0.86
Stationary single-tank door (SSTD)	≤ 0.30	≤ 1.18	≤ 0.55	≤ 0.89
Single-tank conveyor (STC)	≤ 0.85	≤ 0.79	≤ 1.20	≤ 0.70
Multiple-tank conveyor (MTC)	≤ 1.00	≤ 0.54	≤ 1.85	≤ 0.54
Pot, pan, and utensil (PP&U)	–	–	≤ 0.90	≤ 0.58[326]

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Deemed savings values are calculated using the following algorithms:

[323] Low temperature machines apply a chemical sanitizing solution to the surface of the dishes to achieve sanitation.
[324] High temperature machines apply only hot water to the surface of the dishes to achieve sanitation.
[325] ENERGY STAR Commercial Dishwashers Key Product Criteria. https://www.energystar.gov/products/commercial_food_service_equipment/commercial_dishwashers/key_product_criteria.
[326] Water consumption for pot, pan, and utensil is specified in gallons-per-square-foot rather than gallons-per-rack.

$$Energy\ Savings\ [\Delta kWh] = (V_{base} - V_{ES}) \times \left(\frac{\Delta T_{DHW} + \Delta T_{boost}}{\eta_{DHW}}\right) \times \rho_{water} \times C_p \times \frac{1\ kWh}{3{,}412\ Btu} + (E_{idle,base} - E_{idle,ES}) \times \left(1 - N_{racks} \times \frac{t_{wash}}{60}\right) \times DOH \times AOD$$

Equation 115

$$V_{base} = AOD \times DOH \times N_{racks} \times V_{rack,base}$$

Equation 116

$$V_{ES} = AOD \times DOH \times N_{racks} \times V_{rack,ES}$$

Equation 117

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh}{DOH \times AOD} \times CF$$

Equation 118

Where:

ρ_{water}	=	*Density of water [lb/gallon]*
C_p	=	*Specific heat of water [Btu/lb °F]*
ΔT_{DHW}	=	*Inlet water temperature increase for building water heater [°F]*
ΔT_{boost}	=	*Inlet water temperature for booster water heater [°F]*
η_{DHW}	=	*Building electric water heater and booster heater efficiency [%]*
N_{racks}	=	*Number of racks washed per hour*
V_{base}	=	*Baseline annual volume of water consumption [gal/year]*
V_{ES}	=	*ENERGY STAR annual volume of water consumption [gal/year]*
$V_{rack,base}$	=	*Baseline per rack volume of water consumption [gal/rack]*
$V_{rack,ES}$	=	*ENERGY STAR per rack volume of water consumption [gal/rack]*
$E_{Idle,base}$	=	*Baseline idle energy rate [kW]*
$E_{Idle,ES}$	=	*ENERGY STAR idle energy rate [kW]*
t_{wash}	=	*Wash time per rack [min]*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*
3,412	=	*Constant to convert from Btu to kWh*
60	=	*Constant to convert from minutes to hours*
CF	=	*Peak coincidence factor*

Table 157. Dishwashers—Savings Calculation Input Assumptions[327]

Inputs	UC	SSTD	STC	MTC	PP&U
ρ_{water}					61.4 ÷ 7.48 = 8.2
C_p					1.0
ΔT_{DHW}					Gas water heaters: 0ºF Electric water heaters: 70 ºF
ΔT_{boost}					Gas booster heaters: 0 ºF Electric booster heaters: 40 ºF
η_{DHW}					98%
CF[328]					0.90
Low-temperature units					
N_{racks} per hr	4.17	15.560	22.22	33.33	–
$V_{rack,base}$	1.73	2.10	1.31	1.04	–
$V_{rack,ES}$	1.19	1.18	0.79	0.54	–
$E_{idle,base}$	0.50	0.60	1.60	2.00	–
$E_{idle,ES}$	0.25	0.30	0.85	1.00	–
t_{wash}	2.0	1.5	0.3	0.3	–
High-temperature units					
N_{racks} per hr	4.17	15.56	22.22	33.33	15.56
$V_{rack,base}$	1.09	1.29	0.87	0.97	0.70
$V_{rack,ES}$	0.86	0.89	0.70	0.54	0.58
$E_{idle,base}$	0.76	0.87	1.93	2.59	1.20
$E_{idle,ES}$	0.30	0.55	1.20	1.85	0.90
t_{wash}	2.0	1.0	0.3	0.2	3.0

Table 158. Dishwashers—Operating Schedule Assumptions[329]

Building type	DOH	AOD
Education: K-12	6	180
Education: College and university	10	260
All other	18	365

[327] ENERGY STAR Commercial Food Service Equipment Calculator. 7/15/21 amendment to March 2021 update. https://www.energystar.gov/products/commercial_food_service_equipment.

[328] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

[329] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in the following tables are based on the input assumptions specified above. Dual sanitizing dishwashers, with options for high and low temperature sanitization, should select the high temperature savings category unless documentation is provided demonstrating the use of low temperature/chemical sanitization is provided.

Table 159. Dishwashers—Energy and Peak Demand Savings (Education: K-12)

Facility description	UC		SSTD		STC		MTC		PP&U	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Low temp./ electric water heater	650	0.542	2,854	2.378	2,865	2.387	3,993	3.328	–	–
High temp./ electric water heater with electric booster heater	707	0.589	2,071	1.726	1,803	1.502	4,891	4.075	616	0.514
High temp./gas water heater with electric booster heater	529	0.441	916	0.763	1,101	0.918	2,230	1.859	270	0.225
High temp./ electric water heater with gas booster heater	606	0.505	1,411	1.176	1,402	1.168	3,371	2.809	418	0.349

Table 160. Dishwashers—Energy and Peak Demand Savings (Education: College/University)

Facility description	UC		SSTD		STC		MTC		PP&U	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Low temp./ electric water heater	1,565	0.542	6,871	2.378	6,896	2.387	9,613	3.328	–	–
High temp./ electric water heater with electric booster heater	1,703	0.589	4,985	1.726	4,339	1.502	11,774	4.075	1,484	0.514
High temp./gas water heater with electric booster heater	1,275	0.441	2,205	0.763	2,652	0.918	5,370	1.859	650	0.225
High temp./ electric water heater with gas booster heater	1,458	0.505	3,396	1.176	3,375	1.168	8,114	2.809	1,007	0.349

Table 161. Dishwashers—Energy and Peak Demand Savings (All Other)

Facility description	UC		SSTD		STC		MTC		PP&U	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Low temp./ electric water heater	3,955	0.542	17,362	2.378	17,426	2.387	24,292	3.328	–	–
High temp./ electric water heater with electric booster heater	4,303	0.589	12,596	1.726	10,966	1.502	29,751	4.075	3,750	0.514
High temp./gas water heater with electric booster heater	3,221	0.441	5,572	0.763	6,700	0.918	13,569	1.859	1,642	0.225
High temp./ electric water heater with gas booster heater	3,684	0.505	8,582	1.176	8,528	1.168	20,504	2.809	2,545	0.349

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) varies per eligible dishwasher type, as stated in the ENERGY STAR Commercial Kitchen Equipment Savings Calculator.

Table 162. Dishwashers—Equipment Lifetime by Machine Type

Machine type	EUL (years)
Under counter	10
Stationary single-tank door	15
Single-tank conveyor	20
Multiple-tank conveyor	20
Pot, pan, and utensil	10

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly:

- Manufacturer and model number
- Machine type
- Sanitization method (high temperature, low temperature)
- Energy source for primary water heater (gas, electric)
- Energy source for booster water heater (gas, electric)
- ENERGY STAR idle rate
- ENERGY STAR water consumption
- Copy of ENERGY STAR certification or alternative
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility type (Education: K-12, Education: College and university, All other)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 163. Dishwashers—Revision History

TRM version	Date	Description of change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. Update savings based on the newest version of ENERGY STAR deemed input variables.
v2.1	01/30/2015	TRM v2.1 update. Corrections to Water Use per Rack in Table 2-90.

TRM version	Date	Description of change
v3.0	04/30/2015	TRM v3.0 update. Aligned calculation approach with ENERGY STAR Commercial Dishwashers Program Requirements Version 2.0. Simplified methodology to a single representative building type consistent with the ENERGY STAR Commercial Kitchen Equipment Savings Calculator.
v4.0	10/10/2016	TRM v4.0 update. Added high-efficiency requirements for pots, pans, and utensils.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Program tracking requirements updated.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits. Removed ENERGY STAR qualification requirement and defers to meeting criteria.
v9.0	10/2021	TRM v9.0 update. General reference checks and text edits. Updated ENERGY STAR specification and incorporated March 2021 calculator update. Updated variable definitions.
v10.0	10/2022	TRM v10.0 update. Corrected mismatch between formula definitions and variables. Replaced URL for ENERGY STAR listing.
v11.0	10/2023	TRM v11.0 update. Clarified that residential dishwashing equipment can be installed in commercial applications following the methodology in Volume 2 of TRM.
v12.0	10/2024	TRM v12.0 update. Specified reduced operating schedule for education applications and updated corresponding deemed savings tables. Added guidance for dual sanitizing dishwashers and updated documentation requirements.

2.4.5 ENERGY STAR® Electric Griddles Measure Overview

TRM Measure ID: NR-FS-GR

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Business Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of ENERGY STAR commercial electric griddles. Commercial griddles are a versatile piece of cooking equipment with a flat cooking surface whose uses range from searing, browning, toasting, and warming. An energy-efficient commercial electric griddle reduces energy consumption primarily through the application of advanced controls and improved temperature uniformity. The energy and demand savings are determined on a per-griddle basis and only considers electric commercial griddles.

Eligibility Criteria

Eligible units must comply with the current ENERGY STAR specifications.[330] The efficiency requirements for this appliance are evaluated on a per-square-foot basis.

Eligible building types include any nonresidential application.[331]

The following products are excluded from the ENERGY STAR eligibility criteria:

- Gas or dual-fuel heat source griddles
- Dual technology griddles such as fry-top ranges

Baseline Condition

There are currently no federal minimum standards for commercial griddles. Therefore, the baseline condition for retrofit situations is a single-sided or double-sided electric griddle that does not meet the ENERGY STAR key product criteria.

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[330] ENERGY STAR Qualified Product Listing: https://www.energystar.gov/productfinder/product/certified-commercial-griddles/results.

[331] "Commercial Kitchens Initiative," Consortium for Energy Efficiency (CEE). Section 2.2, p. 8. https://forum.cee1.org/system/files/library/4203/CEE_CommKit_InitiativeDescription_Aug2021.pdf.

High-Efficiency Condition

Eligible equipment must be compliant with the current ENERGY STAR v1.2 specification, effective January 1, 2011.[332] Qualified products must meet the minimum idle energy rate requirement from Table 164.

Table 164. Griddles—ENERGY STAR Specification[333]

Operation	Criteria
Cooking energy efficiency at heavy-load conditions	Reported
Normalized idle energy rate	≤ 320 watts/ft^2

Furthermore, the ENERGY STAR qualification criteria do not specify a cooking-energy efficiency threshold and therefore shall only be recorded for evaluation of the energy savings.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

The deemed values are calculated by using the following algorithms:

$$Energy\ Savings\ [\Delta kWh] = kWh_{base} - kWh_{ES}$$

Equation 119

$$kWh_{base} = kWh_{ph,base} + kWh_{cook,base} + kWh_{idle,base}$$

Equation 120

$$kWh_{ES} = kWh_{ph,ES} + kWh_{cook,ES} + kWh_{idle,ES}$$

Equation 121

kWh_{ph}, kWh_{cook}, and kWh_{idle} are each calculated the same for both the baseline and ENERGY STAR cases, as shown in Equation 14, except they require their respective input assumptions relative to preheat, cooking and idle operation as seen in Table 165.

$$kWh = \left(E_{ph} + \left(\frac{W_{food} \times E_{food}}{\eta_{cook}}\right) + E_{idle} \times \left(\left(DOH - \frac{W_{food}}{PC}\right)\right)\right) \times \frac{AOD}{1{,}000}$$

Equation 122

[332] ENERGY STAR Program Requirements for Commercial Griddles. Eligibility Criteria Version 1.2. https://www.energystar.gov/sites/default/files/Commercial%20Griddles%20Version%201.2%20%28Rev%20December%20-%202020%29.pdf.

[333] ENERGY STAR Commercial Griddles Key Product Criteria. https://www.energystar.gov/products/commercial_food_service_equipment/commercial_griddles/key_product_criteria.

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh - \left(\frac{\Delta E_{ph} \times AOD}{1{,}000}\right)}{DOH \times AOD} \times CF$$

Equation 123

Where:

kWh_{base}	=	*Baseline annual energy consumption [kWh]*
kWh_{ES}	=	*ENERGY STAR annual energy consumption [kWh]*
E_{ph}	=	*Preheat energy [Wh/day]*
ΔE_{ph}	=	*Difference in baseline and ENERGY STAR preheat energy*
E_{food}	=	*ASTM energy to food of energy absorbed by food product during cooking [Wh/lb]*
E_{Idle}	=	*Idle energy rate [W]*
W_{food}	=	*Pounds of food cooked per day [lb/day]*
η_{cook}	=	*Cooking energy efficiency [%]*
PC	=	*Production capacity per pan [lb/hr]*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*
1,000	=	*Constant to convert from W to kW*
CF	=	*Peak coincidence factor*

Table 165. Griddles—Savings Calculation Input Assumptions[334]

Parameter	Single-sided		Double-sided	
	Baseline	ENERGY STAR	Baseline	ENERGY STAR
E_{ph} (Wh/ft^2)	667	333	667	333
W_{food} (lb/day/ ft^2)				17
E_{food} (Wh/lb)		139		139
η_{cook} (%)	65%	70%	65%	72%
E_{idle} (W/ft^2)	400	320	400	320
PC (lbs/hr/ft^2)	5.83	6.67	11.67	13.92
CF[335]				0.90

[334] ENERGY STAR Commercial Food Service Equipment Calculator. 7/15/21 amendment to March 2021 update. https://www.energystar.gov/products/commercial_food_service_equipment.

[335] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

Table 166. Griddles—Operating Schedule Assumptions[336]

Building type	DOH	AOD
Education: K-12	6	180
Education: College and university	10	260
All other	12	365

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in the following tables are based on the input assumptions specified above.

Table 167. Griddles—Energy and Peak Demand Savings (Education: K-12)

Griddle size (ft^2)	Single-sided		Double-sided	
	kWh	kW	kWh	kW
< 6	522	0.24	700	0.38
≥ 6 and < 8	783	0.35	1,049	0.57
≥ 8 and < 10	1,044	0.47	1,399	0.77
≥ 10 and < 12	1,305	0.59	1,749	0.96
≥ 12 and < 14	1,566	0.71	2,099	1.15
≥ 14	1,827	0.82	2,449	1.34

Table 168. Griddles—Energy and Peak Demand Savings (Education: College/University)

Griddle size (ft^2)	Single-sided		Double-sided	
	kWh	kW	kWh	kW
< 6	1,087	0.26	1,343	0.35
≥ 6 and < 8	1,630	0.38	2,015	0.52
≥ 8 and < 10	2,174	0.51	2,687	0.69
≥ 10 and < 12	2,717	0.64	3,358	0.86
≥ 12 and < 14	3,261	0.77	4,030	1.04
≥ 14	3,804	0.90	4,702	1.21

[336] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Table 169. Griddles—Energy and Peak Demand Savings (All Other)

Griddle size (ft^2)	Single-sided		Double-sided	
	kWh	kW	kWh	kW
< 6	1,759	0.26	2,120	0.34
≥ 6 and < 8	2,639	0.39	3,179	0.50
≥ 8 and < 10	3,519	0.52	4,239	0.67
≥ 10 and < 12	4,398	0.65	5,299	0.84
≥ 12 and < 14	5,278	0.78	6,359	1.01
≥ 14	6,158	0.92	7,418	1.17

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) Remote Ex-Ante Database Interface (READI) tool for EUL ID Cook-ElecGriddle.[337]

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly.

- Manufacturer and model number
- Griddle top dimensions and surface area
- Griddle configuration (single-sided, double-sided)
- ENERGY STAR idle rate
- Copy of ENERGY STAR certification or alternative
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility type (Education: K-12, Education: College and university, All other)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

[337] DEER READI. http://www.deeresources.com/index.php/readi.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 170. ENERGY STAR Griddles—Revision History

TRM version	Date	Description of change
v11.0	10/2023	TRM v11.0 origin.
v12.0	10/2024	TRMv12.0 update. Specified reduced operating schedule for education applications and updated corresponding deemed savings tables. Updated griddle size to specify a range of griddle sizes based on normal rounding convention. Other minor text updates.

2.4.6 ENERGY STAR® Electric Fryers Measure Overview

TRM Measure ID: NR-FS-EF

Market Sector: Commercial

Measure Category: Cooking equipment

Applicable Building Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of ENERGY STAR electric fryers. Fryers that have earned ENERGY STAR certification offer shorter cook times and higher production rates through advanced burner and heat exchanger designs. Fry pot insulation reduces standby losses resulting in a lower idle energy rate. The energy and demand savings are determined on a per-fryer basis.

Eligibility Criteria

Eligible units must be compliant with the current ENERGY STAR specification, either counter-top or floor type designs, with standard-size and large vat fryers as defined below:[338, 339]

- Standard-size electric fryer: A fryer with a vat that measures ≥ 12 inches and < 18 inches wide, and a shortening capacity ≥ 25 pounds and ≤ 65 pounds
- Large vat electric fryer: A fryer with a vat that measures ≥ 18 inches and ≤ 24 inches wide, and a shortening capacity > 50 pounds

Eligible building types include any nonresidential application.[340]

[338] ENERGY STAR Program Requirements Product Specifications for Commercial Fryers. Eligibility Criteria Version 3.0. https://www.energystar.gov/sites/default/files/asset/document/Commercial%20Fryers%20Program%20Requirements.pdf.

[339] ENERGY STAR Qualified Product Listing: https://www.energystar.gov/productfinder/product/certified-commercial-fryers/results.

[340] CEE Commercial Kitchens Initiative's overview of the Food Service Industry: https://forum.cee1.org/system/files/library/4203/CEE_CommKit_InitiativeDescription_Aug2021.pdf.

The following products are excluded from the ENERGY STAR eligibility criteria:

- Fryers with vats measuring < 12 inches wide, or > 24 inches wide

Baseline Condition

The baseline condition is an electric standard-size fryer or large vat fryer that do not meet ENERGY STAR key product criteria.

High-Efficiency Condition

Eligible equipment must be compliant with the current ENERGY STAR v3.0 specification, effective October 1, 2016. New electric standard fryers and large vat fryers must meet or exceed the requirements listed in Table 171.

Table 171. Fryers—ENERGY STAR Specification[341]

Inputs	Standard	Large vat
Cooking energy efficiency	≥ 83%	≥ 80%
Idle energy rate (W)	≤ 800	≤ 1,100

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Deemed values are calculated using the following algorithms:

$$Energy\ Savings\ [\Delta kWh] = kWh_{base} - kWh_{ES}$$

Equation 124

$$kWh_{base} = kWh_{ph,base} + kWh_{cook,base} + kWh_{idle,base}$$

Equation 125

$$kWh_{ES} = kWh_{ph,ES} + kWh_{cook,ES} + kWh_{idle,ES}$$

Equation 126

kWh_{ph}, kWh_{cook}, and kWh_{idle} are each calculated the same for both the baseline and ENERGY STAR cases, as shown in Equation 127, except they require their respective input assumptions relative to preheat, cooking, and idle operation as seen in Table 172.

[341] ENERGY STAR Commercial Fryers Key Product Criteria. https://www.energystar.gov/products/commercial_food_service_equipment/commercial_fryers/key_product_criteria.

$$kWh = \left(E_{ph} + \left(\frac{W_{food} \times DOH \times E_{food}}{\eta_{\text{cook}}}\right) + E_{idle} \times \left(DOH - \frac{t_{ph}}{60} - \frac{W_{food} \times DOH}{PC}\right)\right) \times \frac{AOD}{1{,}000}$$

Equation 127

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh - \left(\frac{\Delta E_{ph} \times AOD}{1{,}000}\right)}{DOH \times AOD} \times CF$$

Equation 128

Where:

kWh_{base}	=	*Baseline annual energy consumption [kWh]*
kWh_{ES}	=	*ENERGY STAR annual energy consumption [kWh]*
E_{ph}	=	*Preheat energy [Wh/day]*
ΔE_{ph}	=	*Difference in baseline and ENERGY STAR preheat energy*
E_{food}	=	*ASTM energy to food of energy absorbed by food product during cooking [Wh/lb]*
E_{Idle}	=	*Idle energy rate [W]*
W_{food}	=	*Pounds of food cooked per hour [lb/hr]*
η_{cook}	=	*Cooking energy efficiency [%]*
PC	=	*Production capacity [lb/hr]*
t_{ph}	=	*Preheat time [min/day]*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*
60	=	*Constant to convert from min to hr*
1,000	=	*Constant to convert from W to kW*
CF	=	*Peak coincidence factor*

Table 172. Fryers—Savings Calculation Input Assumptions[342]

Parameter		Standard-sized vat		Large vat	
		Baseline	ENERGY STAR	Baseline	ENERGY STAR
E_{ph}		2,400	1,900	2,400	1,900
W_{food}	9.375				12.5
E_{food}					167
η_{cook}		75%	83%	70%	80%
E_{idle}		1,200	800	1,350	1,100
PC		65	70	100	110
t_{ph}					15
CF[343]					0.90

Table 173. Fryers—Operating Schedule Assumptions[344]

Building type	DOH, standard	DOH, large vat	AOD
Education: K-12	6	180	
Education: College and university	10	260	
All other	16	12	365

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in Table 174 are based on the assumptions specified above.

Table 174. Fryers—Energy and Peak Demand Savings

Building type	Fryer type	kWh savings	kW savings
Education: K-12	Standard	650	0.467
	Large vat	704	0.512
Education: College and university	Standard	1,496	0.473
	Large vat	1,619	0.515

[342] ENERGY STAR Commercial Food Service Equipment Calculator. 7/15/21 amendment to March 2021 update. https://www.energystar.gov/products/commercial_food_service_equipment.

[343] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study: Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

[344] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Building type	Fryer type	kWh savings	kW savings
All other	Standard	3,272	0.476
	Large vat	2,696	0.516

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID Cook-ElecFryer.[345]

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly:

- Manufacturer and model number
- Fryer type (standard or large vat)
- ENERGY STAR idle rate
- ENERGY STAR cooking efficiency
- Copy of ENERGY STAR certification or alternative
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility type (Education: K-12, Education: College and university, All other)

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 36779—Provides EUL for Electric Fryers.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

[345] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

Document Revision History

Table 175. Fryers—Revision History

TRM version	Date	Description of change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. No revision.
v3.0	04/10/2015	TRM v3.0 update. Updated to newer ENERGY STAR Electric Fryers Program Requirements Version 2.1. Simplified calculation methodology to a single representative building type consistent with the ENERGY STAR Commercial Kitchen Equipment Savings Calculator.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Savings and efficiencies revised for ENERGY STAR 3.0 specifications. Program tracking requirements updated.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits. Removed ENERGY STAR qualification requirement and defers to meeting criteria.
v9.0	10/2021	TRM v9.0 update. Incorporated March 2021 calculator update. Updated EUL reference.
v10.0	10/2022	TRM v10.0 update. Minor variable definition updates.
v11.0	10/2023	TRM v11.0 update. Updated documentation requirements to collect fryer type rather than fryer width.
v12.0	10/2024	TRM v12.0 update. Specified reduced operating schedule for education applications and updated corresponding deemed savings tables.

2.4.7 ENERGY STAR® Electric Steam Cookers Measure Overview

TRM Measure ID: NR-FS-SC

Market Sector: Commercial

Measure Category: Cooking equipment

Applicable Building Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of ENERGY STAR electric steam cookers. Steam cookers are available in 3-, 4-, 5-, or ≥ 6-pan capacities. Steam cookers that have earned ENERGY STAR certification are up to 50 percent more efficient than standard models. They have higher production rates and reduced heat loss due to better insulation and a more efficient steam delivery system. The energy and demand savings are determined on a per-cooker basis.

Eligibility Criteria

Eligible units must be compliant with the current ENERGY STAR specification.[346, 347] Eligible building types include any nonresidential application..[348]

It is required that the post-retrofit ENERGY STAR electric steam cooker and the conventional steam cooker it replaces are of equivalent pan capacities.

Baseline Condition

The eligible baseline condition for retrofit situations is an electric steam cooker that does not meet ENERGY STAR key product criteria.

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[346] ENERGY STAR Program Requirements Product Specifications for Commercial Steam Cookers. Eligibility Criteria Version 1.2. https://www.energystar.gov/sites/default/files/specs/private/Commercial_Steam_Cookers_Program_Requirements%20v1_2.pdf.

[347] ENERGY STAR Product Listing: https://www.energystar.gov/productfinder/product/certified-commercial-steam-cookers/results.

[348] CEE Commercial Kitchens Initiative's overview of the Food Service Industry: https://forum.cee1.org/system/files/library/4203/CEE_CommKit_InitiativeDescription_Aug2021.pdf.

High-Efficiency Condition

Eligible equipment must be compliant with the current ENERGY STAR v1.2 specification, effective August 1, 2003. Qualified products must meet the requirements from Table 176.

Table 176. Steam Cookers—ENERGY STAR Specification[349]

Pan capacity	Cooking energy efficiency (%)[350]	Idle rate (W)
3-pan	50%	400
4-pan	50%	530
5-pan	50%	670
6-pan and larger	50%	800

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

$$Energy\ Savings\ [\Delta kWh] = kWh_{base} - kWh_{ES}$$

Equation 129

$$kWh_{base} = kWh_{ph,base} + kWh_{cook,base} + kWh_{idle,base}$$

Equation 130

$$kWh_{ES} = kWh_{ph,ES} + kWh_{cook,ES} + kWh_{idle,ES}$$

Equation 131

kWh_{ph}, kWh_{cook}, and kWh_{idle} are each calculated the same for both the baseline and ENERGY STAR cases, as shown in Equation 130, except they require their respective input assumptions relative to preheat, cooking, and idle operation as seen in Table 177.

$$kWh = \left(E_{ph} + \left(\frac{W_{food} \times DOH \times E_{food}}{\eta_{\text{cook}}}\right) + \left[(1 - 40\%) \times E_{idle} + \frac{40\% \times PC \times P \times E_{food}}{\eta_{\text{cook}}}\right] \times \left(1 - \frac{W_{food}}{PC \times P}\right) \times DOH\right) \times \frac{AOD}{1{,}000}$$

Equation 132

[349] ENERGY STAR Commercial Steam Cookers Key Product Criteria. https://www.energystar.gov/products/commercial_food_service_equipment/commercial_steam_cookers/key_product_criteria.

[350] Cooking Energy Efficiency is based on "heavy load (potato) cooking capacity," i.e., 12 by 20 by 2½ inch (300 by 500 by 65 mm) perforated hotel pans each filled with 8.0 ± 0.2 lb (3.6 ± 0.1 kg) of fresh, whole, US No. 1, size B, red potatoes.

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh - \left(\frac{\Delta E_{ph} \times AOD}{1{,}000}\right)}{DOH \times AOD} \times CF$$

Equation 133

Where:

kWh_{base}	=	*Baseline annual energy consumption [kWh]*
kWh_{ES}	=	*ENERGY STAR annual energy consumption [kWh]*
E_{ph}	=	*Preheat energy [Wh/day]*
ΔE_{ph}	=	*Difference in baseline and ENERGY STAR preheat energy*
E_{food}	=	*ASTM energy to food of energy absorbed by food product during cooking [Wh/lb]*
E_{Idle}	=	*Idle energy rate [W]. (Differs for boiler-based and steam-generator equipment)*
W_{food}	=	*Pounds of food cooked per hour [lb/hr]*
η_{cook}	=	*Cooking energy efficiency [%] (Differs for boiler-based or steam generator equipment)*
40%	=	*Percent of time in constant steam mode [%]*
PC	=	*Production capacity [lb/hr]*
P	=	*Pan capacity*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*
1,000	=	*Constant to convert from W to kW*
CF	=	*Peak coincidence factor*

Table 177.Steam Cookers—Savings Calculation Input Assumptions[351]

Parameter	Baseline value	ENERGY STAR value
E_{ph}	1,776	1,671.7
W_{food}		10.81
E_{food}		30.8
η_{cook}	Boiler-based: 26% Steam generator: 30%	50%
E_{Idle}	Boiler-based: 1,000 Steam generator: 1,200	3-pan: 400 4-pan: 530 5-pan: 670 6-pan: 800
PC	23.3	16.7
P		3, 4, 5, or 6
t_{on}		9.25
t_{days}		311
CF[352]		0.90

Table 178. Steam Cookers—Operating Schedule Assumptions[353]

Building ype	DOH	AOD
Education: K-12	6	180
Education: College and university	9.25	260
All other		311

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in the following tables are based on the input assumptions specified above.

[351] ENERGY STAR Commercial Food Service Equipment Calculator. 7/15/21 amendment to March 2021 update. https://www.energystar.gov/products/commercial_food_service_equipment.

[352] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study: Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

[353] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Table 179. Steam Cookers—Energy and Peak Demand Savings (Education: K-12)

Steam cooker type	P	kWh savings	kW savings
Boiler-based	3-pan	3,006	2.489
	4-pan	3,694	3.063
	5-pan	4,367	3.623
	6-pan and larger	5,040	4.185
Steam generator	3-pan	2,528	2.091
	4-pan	3,062	2.536
	5-pan	3,579	2.967
	6-pan and larger	4,095	3.397

Table 180. Steam Cookers—Energy and Peak Demand Savings (Education: College/University)

Steam cooker type	P	kWh savings	kW savings
Boiler-based	3-pan	6,678	2.489
	4-pan	8,211	3.063
	5-pan	9,710	3.623
	6-pan and larger	11,210	4.185
Steam generator	3-pan	5,614	2.091
	4-pan	6,804	2.536
	5-pan	7,955	2.967
	6-pan and larger	9,105	3.397

Table 181. Steam Cookers—Energy and Peak Demand Savings (All Other)

Steam cooker type	P	kWh savings	kW savings
Boiler-based	3-pan	7,988	2.489
	4-pan	9,822	3.063
	5-pan	11,614	3.623
	6-pan and larger	13,408	4.185
Steam generator	3-pan	6,715	2.091
	4-pan	8,139	2.536
	5-pan	9,515	2.967
	6-pan and larger	10,891	3.397

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID Cook-ElecStmCooker.[354]

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly:

- Manufacturer and model number
- Steam cooker type (boiler-based or steam generator)
- Pan capacity (3, 4, 5, or 6+)
- ENERGY STAR idle rate
- ENERGY STAR cooking efficiency
- Copy of ENERGY STAR certification or alternative
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility type (Education: K-12, Education: College and university, All other)

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 40669—Provides energy and demand savings and measure specifications

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 182. Steam Cookers—Revision History

TRM version	Date	Description of change
v1.0	11/25/2013	TRM v1.0 origin.

[354] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

TRM version	Date	Description of change
v2.0	04/18/2014	TRM v2.0 update. Updated EUL based on ENERGY STAR and DEER 2014.
v3.0	04/10/2015	TRM v3.0 update. Updated to newer ENERGY STAR Steam Cooker Program Requirements Version 1.2. Simplified calculation methodology to a single representative building type consistent with the ENERGY STAR Commercial Kitchen Equipment Savings Calculator.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Program tracking requirements updated.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits. Removed ENERGY STAR qualification requirement and defers to meeting criteria.
v9.0	10/2021	TRM v9.0 update. Incorporated March 2021 calculator update. Corrected formula errors. Updated EUL reference.
v10.0	10/2022	TRM v10.0 update. Corrected formula error and minor variable definition updates.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. Specified reduced operating schedule for education applications and updated corresponding deemed savings tables.

2.4.8 Contact Conveyor Toasters

TRM Measure ID: NR-FS-CT

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Business Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section presents the deemed savings methodology for commercial electric contact conveyor toasters. These appliances, which caramelize and transport bread products through a heated chamber via a belt or chain, utilize resistance heating elements within heavy metal plates known as "platens." The design of high-performance conveyor toasters (HPCT) includes advanced features such as internal ambient air heaters and heat shields to optimize thermal efficiency by maintaining consistent temperatures and minimizing heat loss. Dampers at the openings regulate internal airflow, enhancing temperature stability and energy conservation. The energy and demand savings are determined per contact conveyor toaster, and only electric contact conveyor toasters are considered.

Eligibility Criteria

The eligible units must meet the energy-per-sandwich requirement specified in the High Efficiency Condition section. Only contact conveyor toasters qualify for this measure.

Eligible building types include any nonresidential application.

Baseline Condition

Commercial conveyor toasters are not regulated by state or national codes. Therefore, equipment manufacturers often need more incentives to test baseline models. Consequently, the baseline condition for existing models was established using a sample of economy-grade equipment tested by Southern California Edison Foodservice Technology Center (SCE FTC). The base case is defined as a standard performance conveyor toaster with an energy consumption per sandwich exceeding 3.75 W per bun and other specifications shown in Table 183 below.

Generally, new construction is ineligible to claim savings under this measure. However, utilities may work with the EM&V team to determine the baseline standard for new construction applications, if applicable.

Table 183. Contact Conveyor Toasters—Baseline Lab-Tested Specification

Energy per sandwich (W-Hr/bun)	Idle energy rate (kW)	Cooking energy rate (kW)	Preheat energy rate (kW)	Preheat time (min)	Production capacity (units/Hr)
≥ 3.75	0.982	2.04	2.33	21.42	338.00

High-Efficiency Condition

Eligible units must not exceed energy-consumption-per-sandwich of 3.75 W per bun, as calculated in Equation 134, and other lab-tested specifications, as shown in Table 184. This is assessed following the ASTM F2380-18 test procedure.[355] The specification was developed based on lab-based equipment performance tests conducted collaboratively by the Pacific Gas & Electric (PG&E) Food Service Technology Center (FSTC) and SCE FTC.

In absence of lab testing, eligible products must be included on the current California Energy Wise Foodservice Qualified Product Listing (QPL).[356]

Table 184. Contact Conveyor Toasters—Lab-Tested Specifications

Energy per sandwich (W-Hr/bun)	Idle energy rate (kW)	Cooking energy rate (kW)	Preheat energy rate (kW)	Preheat time (min)	Production capacity (units/Hr)
≤ 3.75	0.64	2.06	2.12	9.83	698

$$Energy\ per\ sandwich = \frac{E_{cook} \times 1{,}000}{PC}$$

Equation 134

Where:

E_{cook} = *Cooking energy rate [kW]*

1,000 = *Constant to convert from W to kW*

PC = *Production capacity (buns/hour)*

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

The deemed values are calculated by using the following algorithms:

[355] ASTM Standard Test Method for Performance of Conveyor Toasters. https://www.astm.org/f2380-18.html.

[356] California Energy Wise Foodservice QPL. https://caenergywise.com/instant-rebates/qpl/. For assistance with qualifying new models, reach out to the California Foodservice Instant Rebates program. https://caenergywise.com/instant-rebates/#contact-us.

$$Energy\ Savings\ [\Delta kWh] = kWh_{base} - kWh_{ES}$$

Equation 135

$$kWh_{base} = kWh_{ph,base} + kWh_{cook,base} + kWh_{idle,base}$$

Equation 136

$$kWh_{ES} = kWh_{ph,ES} + kWh_{cook,ES} + kWh_{idle,ES}$$

Equation 137

kWh_{ph}, kWh_{cook}, and kWh_{idle} are each calculated the same for both the baseline and high-efficiency cases, as shown in Equation 136, and the peak demand savings calculation, as shown in Equation 139, except they require their respective input assumptions relative to preheat, cooking, and idle operation, as seen in Table 185.

$$kWh = \left(\left(E_{ph} \times N_{ph} \times \frac{t_{ph}}{60}\right) + \left(\frac{E_{cook} \times N_{buns}}{PC}\right) + \left(E_{idle} \times \left(t_{on} - \frac{N_{buns}}{PC} - \frac{N_{ph} \times t_{ph}}{60}\right)\right)\right) \times t_{days}$$

Equation 138

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh}{t_{on} \times t_{days}} \times CF$$

Equation 139

Where:

kWh_{base}	=	*Baseline annual energy consumption [kWh]*
kWh_{HE}	=	*High-efficiency annual energy consumption [kWh]*
kWh_{ph}	=	*Preheat energy [kWh]*
kWh_{cook}	=	*Cooking energy [kWh]*
kWh_{idle}	=	*Idle energy [kWh]*
E_{ph}	=	*Preheat energy rate [kW]*
E_{Idle}	=	*Idle energy rate [kW]*
N_{ph}	=	*Number of preheats per day*
N_{buns}	=	*Number of sandwich buns cooked per day*
t_{ph}	=	*Estimated preheat time [min]*
60	=	*Constant to convert from minutes to hours*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*
CF	=	*Peak coincidence factor*

Table 185. Contact Conveyor Toasters—Savings Calculation Input Assumptions[357]

Parameter	Baseline	High efficiency
E_{ph} (kW)	2.33	2.12
E_{cook} (kW)	2.04	2.06
E_{idle} (kW)	0.98	0.64
PC (buns/hr)	338	698
N_{ph} (PH/day)		1
N_{buns} (buns/day)[358]		650
t_{ph} (min)	21	10
CF[359]		0.90

Table 186. Contact Conveyor Toasters—Operating Schedule Assumptions[360]

Building type	DOH	AOD
Education: K-12	6	180
Education: College and university	10	260
All other	16	364

Deemed Energy and Demand Savings Tables

The following table provides the estimated energy and demand savings per contact conveyor toaster based on the input assumptions from Table 185.

Table 187. Contact Conveyor Toasters—Energy and Peak Demand Savings

Building Type	Energy savings (kWh)	Peak demand savings (kW)
Education: K-12	550	0.46
Education: College and university	1,150	0.40
All other	2,358	0.36

[357] Input assumptions primarily informed by lab-based equipment performance tests conducted by the SCE FTC and PG&E FSTC.

[358] Emerging Technologies, "High-Performance Conveyorized Toaster: ET18SCE1120." June 2020. p. 31. https://www.caetrm.com/media/reference-documents/2020-06-12_h.e._toaster_report_final_draft.pdf.

[359] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17. https://www.caetrm.com/media/reference-documents/Itron_2005_DEER_2004-05_UpdateFinalReport.pdf.

[360] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

There is no estimated useful life (EUL) specifically for an electric toaster, but its method of operation is similar to that of an electric convection oven. Therefore, the EUL is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) Remote Ex-Ante Database Interface (READI) tool for EUL ID Cook-ElecConvOven.[361]

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly.

- Building type
- Toaster quantity
- Manufacturer and model number
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility equipment AOD and DOH (if available)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 188. Contact Conveyor Toasters—Revision History

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 origin.

[361] California Public Utilities Commission (CPUC), Energy Division. 2020. https://www.caetrm.com/media/reference-documents/EEPolicyManualRevised_032020.pdf

2.4.9 Radiant Conveyor Toasters

TRM Measure ID: NR-FS-RT

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Business Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of commercial radiant conveyor toasters. A radiant conveyor toaster is an appliance that uses radiant heat to toast baked goods on both sides. It is placed on a belt and carried through a heated chamber, dropping to an unheated holding area for product pickup once the toasting cycle is complete.

Advanced radiant conveyor toasters optimize energy usage by employing sensors to detect activity. Energy-efficient models feature a setback mode, which reduces energy consumption during periods of activity by lowering cavity temperature and slowing or stopping the conveyor belt.

Eligibility Criteria

The eligible product must pertain to conveyor toasters that use radiant heat as the primary heat source for testing and utilize automation in activating an energy setback mode described in the High-Efficiency Condition section.

Eligible building types include any nonresidential application.

Baseline Condition

Commercial radiant toasters are not regulated by state or national codes. Therefore, equipment manufacturers often need more incentives to test baseline models. Consequently, the baseline condition for existing models was established using a sample of economy-grade equipment tested by the Southern California Edison Foodservice Technology Center (SCE FTC). The baseline condition is a radiant conveyor toaster without an automatic setback mode, whose specifications are shown in Table 189 below.

Generally, new construction is ineligible to claim savings under this measure. However, utilities may work with the EM&V team to determine the baseline standard for new construction applications, if applicable.

Table 189. Radiant Conveyor Toasters—Baseline Specification[362]

Outlet voltage	Time in cooking mode (%)
120 V	100%
208/240 V	

High-Efficiency Condition

The industry standard for evaluating radiant conveyor toaster energy consumption performance is the American Society Testing and Materials (ASTM) Standard F2380.[363] This standard provides precise metrics that define radiant conveyor toaster energy performance.

- *Cooking rate:* The energy consumption of the toaster while conducting active toasting operations. The cooking rate can vary slightly depending on the exact heat settings, but it is generally close to the manufacturer-rated input.
- *Idle rate*: The energy consumption of the toaster while maintaining a ready-to-toast state unless an energy-saving or setback mode is activated. This is identical to the cooking rate.
- *Production capacity:* The toaster's maximum rate (slices per hour) can toast the product.

The eligible product must be a radiant conveyor toaster with automatic energy savings or setback mode and meet the specifications in Table 190. The specification was developed based on lab-based equipment performance tests conducted collaboratively by the Pacific Gas & Electric (PG&E) Food Service Technology Center (FSTC) and SCE FTC.

In absence of lab testing, eligible products must be included on the current California Energy Wise Foodservice Qualified Product Listing (QPL).[364]

Table 190. Radiant Conveyor Toasters—Lab-Tested Specification[365]

Outlet voltage	Time in cooking mode (%)
120 V	66.2%
208/240 V	

[362] Energy Solutions (ES). 2022. "Conveyor Toaster Supporting Data."
[363] Standard Test Method for Performance of Conveyor Toasters: https://www.astm.org/f2380-18.html.
[364] CA Energy Wise Foodservice QPL. https://caenergywise.com/instant-rebates/qpl/. For assistance with qualifying new models, reach out to the California Foodservice Instant Rebates program. https://caenergywise.com/instant-rebates/#contact-us.
[365] Energy Solutions (ES). 2022. "Conveyor Toaster Supporting Data."

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

The deemed values are calculated by using the following algorithms:

$$Energy\ Savings\ [\Delta kWh] = kWh_{base} - kWh_{ES}$$

Equation 140

$$kWh_{base} = kWh_{cook,base} + kWh_{idle,base}$$

Equation 141

$$kWh_{ES} = kWh_{cook,ES} + kWh_{idle,ES}$$

Equation 142

kWh_{cook}, and kWh_{idle} are each calculated the same for both the baseline and high-efficiency cases, as shown in Equation 141Equation 101, except they require their respective input assumptions, as seen in Table 191.

$$kWh = kW_{input} \times \big(PTCM + (PTSM \times SEF)\big) \times DOH \times AOD$$

Equation 143

Where:

kWh_{base}	=	*Baseline annual energy consumption [kWh]*
kWh_{ES}	=	*High-efficiency annual energy consumption [kWh]*
kWh_{cook}	=	*Cooking energy [kWh]*
kWh_{idle}	=	*Idle energy [kWh]*
kW_{input}	=	*Average toaster input rate [kW]*
PTCM	=	*Percentage time spent in cooking mode [%]; see Table 189 and Table 190*
PTSM	=	*Percentage time spent in setback mode = 1 – PTCM [%]*
SEF	=	*Setback energy factor [%]*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*

Table 191. Radiant Conveyor Toasters—Savings Calculation Input Assumptions[366]

Parameter	Baseline		High efficiency	
	120 V	208/240 V	120 V	208/240 V
kW_{input}	1.58	2.92	1.45	2.67
SEF				41.9%

Table 192. Radiant Conveyor Toasters—Operating Schedule Assumptions[367]

Building Type	DOH	AOD
Education: K-12	6	180
Education: College and university	10	260
All other	10.4	344

Deemed Energy Savings Tables

The following table provides the estimated energy savings per radiant conveyor toaster based on the input assumptions from Table 191. Radiant Conveyor Toasters—Savings Calculation Input AssumptionsTable 191Equation 191.

Table 193. Radiant Conveyor Toaster—Energy Savings

Building type	Outlet voltage	Annual energy savings (kWh)
Education: K-12	120 V	454
	208/240 V	836
Education: College and university	120 V	1,093
	208/240 V	2,014
All other	120 V	1,507
	208/240 V	2,778

[366] Input assumptions primarily informed by lab-based equipment performance tests conducted by the SCE FTC and PG&E FSTC.

[367] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Deemed Demand Savings Tables

No peak demand savings are associated with the radiant conveyor toaster measure. Electric savings are expected during off-peak periods when the radiant conveyor toaster is not in active use. Peak periods will not exhibit substantial differences between baseline and efficient case radiant conveyor toasters.

Claimed Peak Demand Savings

Not applicable.

Measure Life and Lifetime Savings

There is no estimated useful life (EUL) specifically for an electric toaster, but its method of operation is similar to that of an electric convection oven. Therefore, the EUL is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) Remote Ex-Ante Database Interface (READI) tool for EUL ID Cook-ElecConvOven.[368]

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly.

- Building type
- Toaster quantity
- Manufacturer and model number
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility equipment AOD and DOH (if available)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

[368] California Public Utilities Commission (CPUC), Energy Division. 2020. https://www.caetrm.com/media/reference-documents/EEPolicyManualRevised_032020.pdf

Document Revision History

Table 194. Radiant Conveyor Toasters—Revision History

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 origin.

2.4.10ENERGY STAR® Hot Food Holding Cabinets Measure Overview

TRM Measure ID: NR-FS-HC

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Building Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of ENERGY STAR hot food holding cabinets (HFHCs). An HFHC is a heated, fully enclosed compartment with one or more solid or transparent doors designed to maintain the temperature of hot food that has been cooked using a separate appliance. HFHCs that have earned ENERGY STAR certification incorporate better insulation, thus reducing heat loss, and may also offer additional energy-saving devices such as magnetic door gaskets, auto-door closers, or Dutch doors. The insulation of the cabinet offers better temperature uniformity within the cabinet from top to bottom. The energy and demand savings are deemed and based on an interior volume range of the holding cabinets and the building type. An average wattage has been calculated for each volume range, half size, three-quarter size, and full size. The energy and demand savings are determined on a per-cabinet basis.

Eligibility Criteria

HFHCs must be compliant with the current ENERGY STAR specification.[369, 370] Eligible building types include any nonresidential application.[371]

[369] ENERGY STAR Program Requirements Product Specifications for Commercial Hot Food Holding Cabinets. Eligibility Criteria Version 2.0. https://www.energystar.gov/sites/default/files/specs/private/Commercial_HFHC_Program_Requirements_2.0.pdf.

[370] ENERGY STAR Qualified Product Listing: https://www.energystar.gov/productfinder/product/certified-commercial-hot-food-holding-cabinets/results.

[371] CEE Commercial Kitchens Initiative's overview of the Food Service Industry: https://forum.cee1.org/system/files/library/4203/CEE_CommKit_InitiativeDescription_Aug2021.pdf.

The following products are excluded from the ENERGY STAR eligibility criteria:

- Dual function equipment (e.g., "cook-and-hold" and proofing units)
- Heated transparent merchandising cabinets
- Drawer warmers

Baseline Condition

The baseline condition is a half-size, three-quarter size, or full-size hot food holding cabinet that do not meet ENERGY STAR key product criteria.

High-Efficiency Condition

Eligible equipment must be compliant with the current ENERGY STAR v2.0 specification, effective October 1, 2011. Table 195 summarizes idle energy rate requirement based on cabinet interior volume.

Table 195. HFHCs—ENERGY STAR Specification[372,373]

Product interior volume (ft^3)	Idle energy rate (W)
0 < V < 13	≤ 21.5 V
13 ≤ V < 28	≤ 2.0 V + 254.0
28 ≤ V	≤ 3.8 V + 203.5

Energy and Demand Savings Methodology

Savings Calculations and Input Variables

Deemed values are calculated using the following algorithms:

$$Energy\ Saving\ [\Delta kWh] = \left(E_{Idle,base} - E_{Idle,ES}\right) \times \frac{1}{1{,}000} \times t_{on} \times t_{days}$$

Equation 144

$$Peak\ Demand\ [\Delta kW] = \left(E_{Idle,base} - E_{Idle,ES}\right) \times \frac{1}{1{,}000} \times CF$$

Equation 145

[372] ENERGY STAR Commercial Fryers Key Product Criteria. https://www.energystar.gov/products/commercial_food_service_equipment/commercial_hot_food_holding_cabinets/key_product_criteria.

[373] V = Interior Volume which equals Interior Height x Interior Width x Interior Depth.

Where:

V	=	*Product interior volume [ft^3]*
$E_{Idle,base}$	=	*Baseline idle energy rate [W]*
$E_{Idle,ES}$	=	*ENERGY STAR idle energy rate after installation [W]*
DOH	=	*Equipment daily operating hours [hrs/day]*
AOD	=	*Facility annual operating days [days/year]*
1,000	=	*Constant to convert from W to kW*
CF	=	*Peak coincidence factor*

Table 196. HFHCs—Savings Calculation Input Assumptions[374]

Input variable	Product interior volume range		
	0 < V < 13	13 ≤ V < 28	28 ≤ V
V[375]	8	22	53
$E_{Idle,base}$			30 × V
$E_{Idle,ES}$	21.5 × V	2 × V + 254	3.8 × V + 203.5
CF[376]			0.90

Table 197. HFHCs—Operating Schedule Assumptions[377]

Building type	DOH	AOD
Education: K-12	6	180
Education: College and university	9	260
All other		365

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in Table 198 are based on the input assumptions specified above.

[374] ENERGY STAR Commercial Food Service Equipment Calculator. 7/15/21 amendment to March 2021 update. https://www.energystar.gov/products/commercial_food_service_equipment.

[375] Averages of product interior volume determined based on review of ENERGY STAR qualified product listing. Accessed 7/30/2020.

[376] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

[377] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Table 198. HFHCs—Energy and Peak Demand Savings

Building type	Product interior volume (ft^3)	kWh savings	kW savings
Education: K-12	0 < V < 13	73	0.061
	13 ≤ V < 28	391	0.326
	28 ≤ V	1,280	1.067
Education: College and university	0 < V < 13	159	0.061
	13 ≤ V < 28	847	0.326
	28 ≤ V	2,773	1.067
All other	0 < V < 13	223	0.061
	13 ≤ V < 28	1,189	0.326
	28 ≤ V	3,893	1.067

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID Cook-HoldCab.[378]

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly:

- Manufacturer and model number
- Interior cabinet volume
- ENERGY STAR idle rate
- Copy of ENERGY STAR certification or alternative
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility type (Education: K-12, Education: College and university, All other)

[378] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 36779—Provides EUL for Hot Food Holding Cabinets

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 199. HFHCs—Revision History

TRM version	Date	Description of change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. No revision.
v3.0	04/10/2015	TRM v3.0 update. Updated to newer ENERGY STAR Hot Food Holding Cabinet Program Requirements Version 2.0. Simplified calculation methodology to a single representative building type consistent with the ENERGY STAR Commercial Kitchen Equipment Savings Calculator.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Program tracking requirements updated.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits. Removed ENERGY STAR qualification requirement and defers to meeting criteria.
v9.0	10/2021	TRM v9.0 update. Incorporated March 2021 calculator update. Updated EUL reference.
v10.0	10/2022	TRM v10.0 update. Minor formatting.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. Specified reduced operating schedule for education applications and updated corresponding deemed savings tables.

2.4.11 ENERGY STAR® Refrigerated Chef Bases

TRM Measure ID: NR-FS-CB

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Building Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of ENERGY STAR refrigerated chef bases. A refrigerated chef base is used to keep ingredients, or prepared meals close to the cooking station, making food preparation more efficient. The capacity or size of a chef base is represented by its refrigerated volume. The refrigerated compartment can be equipped with drawers or doors according to customer specifications. A typical chef base operates using a conventional vapor compression refrigeration cycle charged with R-404a or R-290 propane. The energy and demand savings are determined on a per-volume basis.

Eligibility Criteria

Qualifying chef base models must meet ENERGY STAR Commercial Refrigerators and Freezers Version 5.0 specifications for chef bases.

Eligible building types include any non-residential application.[379]

The following products are excluded from the eligibility criteria:

- Used or rebuilt equipment

Baseline Condition

The baseline condition for retrofit situations is a refrigerated chef base unit that does not meet the ENERGY STAR key product criteria.

[379] "Commercial Kitchens Initiative," Consortium for Energy Efficiency (CEE). Section 2.2, p. 8. https://forum.cee1.org/system/files/library/4203/CEE_CommKit_InitiativeDescription_Aug2021.pdf.

High-Efficiency Condition

Qualifying chef base models must meet ENERGY STAR Version 5.0 specifications and comply with the maximum daily energy consumption (MDEC) value corresponding to its refrigerated volume, as specified by the equation 0.05 x V + 2.1 (where V equals total refrigerated volume).

Energy and Demand Savings Methodology

Savings Calculations and Input Variables

The deemed values are calculated by using the following algorithms:

$$Energy\ Savings\ [\Delta kWh] = \left(kWh_{daily,base} - kWh_{daily,ES}\right) \times AOD$$

Equation 146

Where:

$kWh_{daily,base}$ = *Average daily operational energy consumption, baseline [kWh]*

$kWh_{daily,ES}$ = *Average daily operational energy consumption, efficient case [kWh]*

Daily average energy consumption for the baseline is estimated using the equation provided in the ENERGY STAR CFS Calculator for Conventional Refrigerated Chef Bases. The estimate for baseline daily energy consumption is shown in Equation 147. The input assumptions for refrigerated volume used the ENERGY STAR QPL to determine the average volume within each of four volume ranges, shown in Table 200. Annual kW_{avg} is calculated the same for both the baseline and high-efficiency cases, as shown in Equation 148, where it is assumed that the average electric demand for any time interval is the same throughout the day and the peak demand can be calculated by dividing the daily energy consumption by 24 hours. Peak demand savings are calculated with Equation 148 using their respective input assumptions from Table 201.

$$kWh_{daily,base} = 0.05 \times V + 2.625$$

Equation 147

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh_{daily}}{24} \times CF$$

Equation 148

Where:

CF = *Peak coincidence factor[380] = 0.9*

[380] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

Table 200. Refrigerated Chef Bases—Refrigerated Volumes for Baseline

Refrigerated volume (ft^3)	Average refrigerated volume (ft^3)
$0 < V \leq 7.5$	4.42
$7.5 < V \leq 15$	11.06
$15 < V \leq 22.5$	18.43
$22.5 < V \leq 30$	23.94

Table 201. Refrigerated Chef Bases—Daily Energy Consumption[381]

Refrigerated volume (ft^3)	$kWh_{daily,base}$	$kWh_{daily,ES}$
$0 < V \leq 7.5$	2.846	1.254
$7.5 < V \leq 15$	3.178	2.230
$15 < V \leq 22.5$	3.546	2.368
$22.5 < V \leq 30$	3.822	1.770

Table 202. Refrigerated Chef Bases—Operating Schedule Assumptions[382]

Building type	AOD
Education: K-12	180
Education: College and university	260
All other	365

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in the following table are based on the input assumptions from Table 200 through Table 202.

[381] ENERGY STAR Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment. http://www.energystar.gov/buildings/sites/default/uploads/files/Commercial_kitchen_equipment_calculator.xlsx

[382] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Table 203. Refrigerated Chef Bases—Annual Energy and Peak Demand Savings[383]

Building type	Refrigerated volume (ft3)	Energy savings [kWh]	Peak demand savings [kW]
Education: K-12	0 < V ≤ 7.5	287	0.06
	7.5 < V ≤ 15	171	0.04
	15 < V ≤ 22.5	212	0.04
	22.5 < V ≤ 30	369	0.08
Education: College and university	0 < V ≤ 7.5	414	0.06
	7.5 < V ≤ 15	247	0.04
	15 < V ≤ 22.5	306	0.04
	22.5 < V ≤ 30	534	0.08
All other	0 < V ≤ 7.5	581	0.06
	7.5 < V ≤ 15	346	0.04
	15 < V ≤ 22.5	430	0.04
	22.5 < V ≤ 30	749	0.08

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

Currently, no lifetime value is specified for this measure in the California Database of Energy Efficiency Resources (DEER) Remote Ex-Ante Database Interface (READI) tool. The estimated useful life (EUL) is 12 years, as specified in the ENERGY STAR Commercial Food Service Savings Calculator.[383]

Program Tracking Data and Evaluation Requirements

To ensure that the appropriate incentives, savings, and cost-effectiveness values are applied for each application, the following data must be collected for each application:

- Equipment manufacturer and model number
- Refrigerated Chef Base Volume
- Building Location

[383] ENERGY STAR Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment. http://www.energystar.gov/buildings/sites/default/uploads/files/Commercial_kitchen_equipment_calculator.xlsx

- Building Type
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Recommended: Facility equipment AOD and DOH
- Copy of ENERGY STAR certification or alternative

References and Efficiency Standards

Petitions and Rulings

PUCT Docket 36779 provides EUL estimates for commercial refrigerators and freezers.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 204. Refrigerated Chef Bases—Revision History

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 origin.

2.4.12ENERGY STAR® Ice Makers Measure Overview

TRM Measure ID: NR-FS-IM

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Building Types: Any commercial

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section covers the deemed savings methodology for the installation of ENERGY STAR automatic ice makers installed in commercial sites.

Eligibility Criteria

Eligible equipment includes air-cooled batch and continuous ice makers with the following design types: ice-making head (IMH), self-contained (SCU), and remote condensing (RCU) units. Eligible units must be compliant with the current ENERGY STAR specification.[384, 385]

Any commercial-type building is eligible; building types include independent restaurants, chain restaurants, elementary and secondary schools, colleges and universities, corporate and industrial foodservice operations, healthcare, hospitality, and supermarkets.[386]

The following products are excluded from the ENERGY STAR eligibility criteria:

- Water-cooled ice makers
- Ice makers with ice and water dispensing systems
- Air-cooled RCUs that are designed only for connection to remote rack compressors

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[384] ENERGY STAR Program Requirements Product Specifications for Commercial Ice Makes. Eligibility Criteria Version 3.0. https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Final%20Draft%20Version%203.0%20Automatic%20Commercial%20Ice%20Maker%20Specification.pdf.

[385] ENERGY STAR Qualified Product Listing: https://www.energystar.gov/productfinder/product/certified-commercial-ice-machines/results.

[386] CEE Commercial Kitchens Initiative's overview of the Food Service Industry: https://forum.cee1.org/system/files/library/4203/CEE_CommKit_InitiativeDescription_Aug2021.pdf.

Baseline Condition

The baseline condition is an ice maker meeting the federal standards published in 10 CFR 431 listed in Table 205. The baseline applies to automatic air-cooled commercial ice maker with capacities between 50 and 4,000 pounds per 24-hour period manufactured on or after January 28, 2018.

Table 205. Ice Makers—Federal Standard[387]

Equipment type	Harvest rate (lbs ice per 24 hrs)	Max energy use rate (kWh/100 lb ice) H=harvest rate
Batch		
IMH	< 300	10 - 0.01233H
	≥ 300 and < 800	7.05 - 0.0025H
	≥ 800 and < 1,500	5.55 - 0.00063H
	≥ 1,500 and < 4,000	4.61
RCU (but not remote compressor)	< 988	7.97 - 0.00342H
	≥ 988 and < 4,000	4.59
RCU and remote compressor	< 930	7.97 - 0.00342H
	≥ 930 and < 4,000	4.79
SCU	< 110	14.79 - 0.0469H
	≥ 110 and < 200	12.42 - 0.02533H
	≥ 200 and < 4,000	7.35
Continuous		
IMH	< 310	9.19 - 0.00629H
	≥ 310 and < 820	8.23 - 0.0032H
	≥ 820 and < 4,000	5.61
RCU (but not remote compressor)	< 800	9.7 - 0.0058H
	≥ 800 and < 4,000	5.06
RCU and remote compressor	< 800	9.9 - 0.0058H
	≥ 800 and < 4,000	5.26
SCU	< 200	14.22 - 0.03H
	≥ 200 and < 700	9.47 - 0.00624H
	≥ 700 and < 4,000	5.1

[387] Code of Federal Regulations, Title 10 Part 431.136 for air-cooled batch-type and continuous-type automatic commercial ice maker with capacities between 50 and 4,000 pounds per 24-hour period manufactured on or after January 28, 2018. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=53.

High-Efficiency Condition

Eligible equipment must be compliant with the current ENERGY STAR v3.0 specification, effective January 28, 2018. Qualified products must meet the minimum energy consumption (kWh/100 lbs. ice) from Table 206.

Table 206. Ice Makers—ENERGY STAR Specification[388]

Equipment type	Harvest rate (lbs ice per 24 Hrs)	Max energy use rate (kWh/100 lb ice) H=harvest rate
Batch		
IMH	H < 300	< 9.20 - 0.01134H
	300 ≤ H < 800	< 6.49 - 0.0023H
	800 ≤ H < 1500	< 5.11 - 0.00058H
	1500 ≤ H ≤ 4000	< 4.24
RCU	H < 988	< 7.17 – 0.00308H
	988 ≤ H ≤ 4000	< 4.13
SCU	H < 110	< 12.57 - 0.0399H
	110 ≤ H < 200	< 10.56 - 0.0215H
	200 ≤ H ≤ 4000	< 6.25
Continuous		
IMH	H < 310	< 7.90 – 0.005409H
	310 ≤ H < 820	< 7.08 – 0.002752H
	820 ≤ H ≤ 4000	< 4.82
RCU	H < 800	< 7.76 – 0.00464H
	800 ≤ H ≤ 4000	< 4.05
SCU	H < 200	< 12.37 – 0.0261H
	200 ≤ H < 700	< 8.24 – 0.005429H
	700 ≤ H ≤ 4000	< 4.44

Energy and Demand Savings Methodology

Average harvest rates per design-type were computed for both batch and continuous ice makers utilizing the ENERGY STAR qualified products listing for commercial ice makers for the purpose of possibly establishing deemed savings but were determined to be too variable. Therefore, savings for air-cooled batch and continuous commercial ice makers are dependent on the harvest rate and can be calculated using the following algorithms:

[388] ENERGY STAR Commercial Ice Maker Key Product Criteria . https://www.energystar.gov/products/commercial_food_service_equipment/commercial_ice_makers/key_product_criteria.

Savings Algorithms and Input Variables

$$Energy\ Savings\ [\Delta kWh] = (E_{base} - E_{\mathrm{ES}}) \times \frac{H}{100} \times DC \times AOD$$

Equation 149

$$Peak\ Demand\ Savings\ [\Delta kW] = \Delta kWh \times CF$$

Equation 150

Where:

E_{base}	=	*Baseline rated energy consumption (kWh) per 100 pounds of ice (see Table 205)*
E_{ES}	=	*ENERGY STAR rated energy consumption (kWh) per 100 pounds of ice (see Table 206)*
H	=	*Harvest rate in pounds of ice produced per 24 hours*
DC	=	*Machine duty cycle, 75%*[389]
AOD	=	*Facility annual operating days (see Table 207)*
CF	=	*Seasonal peak coincidence factor (see Table 208)*

Table 207. Ice Makers—Operating Schedule Assumptions[390]

Building type	AOD
Education: K-12	180
Education: College and university	260
All other	365

Table 208. Ice Makers—Seasonal Peak CFs[391]

Climate zone	Summer	Winter
Climate Zone 1: Amarillo	0.00012	0.00011
Climate Zone 2: Dallas		
Climate Zone 3: Houston		

[389] The assumed duty cycle value of 80 percent is taken from a PGE Emerging Technologies study, ET Project #ET12PGE3151 Food Service Technology—Efficient Ice Machines and Load Shifting, average duty cycle of preexisting machines in tables ES1 and ES2.

[390] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

[391] Probability weighted peak load factors are calculated according to the method in Section 4 of the Texas TRM Vol 1 using data from the EPRI Load Shape Library 6.0. ERCOT Regional End Use Load Shapes for Commercial Refrigeration. *Peak Season* and *Peak Weekday* values used for summer calculations. *Off Peak Season* and *Peak Weekday* values used for winter calculations. http://loadshape.epri.com/enduse.

Climate zone	Summer	Winter
Climate Zone 4: Corpus Christi		0.00012
Climate Zone 5: El Paso		

Deemed Energy Savings Tables

There are no deemed energy savings tables for this measure.

Deemed Summer and Winter Demand Savings Tables

There are no deemed demand savings tables for this measure.

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for automatic ice makers is 8.5 years.[392]

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone
- Manufacturer and model number
- Machine type
    - IMH, RC, or SCU
    - Batch or continuous
- Machine harvest rate
- Copy of ENERGY STAR certification or alternative
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility type (Education: K-12, Education: College and university, All other)

[392] Department of Energy, Energy Conservation Program: Energy Conservation Standards for Automatic Commercial Ice Makers, 80 FR 4698, https://www.federalregister.gov/d/2015-00326/p-4698.

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 209. Ice Makers—Revision History

TRM version	Date	Description of change
v7.0	10/2019	TRM v7.0 origin.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits.
v9.0	10/2021	TRM v9.0 update. Incorporated March 2021 calculator update.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. Specified reduced operating schedule for education applications and updated corresponding deemed savings tables.

2.4.13ENERGY STAR® Induction Cooktops

TRM Measure ID: NR-FS-IC

Market Sector: Commercial

Measure Category: Appliances

Applicable Building Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

A cooktop is cooking appliance that heats a cooking container, such as a pot or pan, to cook the food inside. As a primary cooking tool in commercial and residential applications, cooktops have developed designs customized to specific needs. However, commercial cooktops generally have significantly more durable construction than their residential counterparts.

Cooktops, available in gas and electric varieties, are one of the primary appliances in nearly every commercial kitchen. They are used for various cooking applications such as sautéing, braising, simmering, and boiling. Commercial kitchens can generally be expected to have at least two burners, with standard configurations including a six-foot range top.

Induction cooktops generate a magnetic field that excite the molecules of the cookware. This direct heating process makes the cooking extremely responsive to the cooktop controls. The induction process also minimizes hot surfaces for reduced safety risks and is more energy efficient than alternative cooking processes. However, it's important to note that any cookware used with induction cooktops must be induction compatible, meaning they must be made of ferromagnetic material such as cast iron or most types of stainless steel. Full aluminum or copper cookware will not work with induction cooktops.

American Society for Testing and Materials (ASTM) F1521 is the industry standard for evaluating cooktop energy consumption and performance.[393] This standard for range top performance is a testament to the rigorous testing and quality control that goes into the production of induction cooktops.

[393] ASTM F1521-12(2018) Standard Test Method for Performance of Range Tops: https://www.astm.org/f1521-12r18.html

The following metrics define the range of top energy performance:

- *Cooking efficiency:* The energy consumption of the cooktop while heating water in a pot from ambient conditions to 200°F.
- *Production capacity:* The maximum rate (pound per hour) at which the cooktop can heat food products.

Eligibility Criteria

Eligible units must comply with the current ENERGY STAR specification. Qualified products must also meet the minimum cooking (boil) energy efficiency requirement from Table 210.

Eligible building types include any nonresidential application.

Baseline Condition

There are currently no federal minimum standards for commercial electric cooktops. Therefore, the baseline condition is defined as an electric range with an electric resistance cooktop or a standalone electric resistance cooktop that does not meet ENERGY STAR key product criteria.

High-Efficiency Condition

The high-efficiency condition is the current ENERGY STAR v1.0 specification, effective September 1, 2023.[394] Induction cooktops must be ENERGY STAR-compliant.[395]

Table 210. Induction Cooktops—ENERGY STAR Specification

Operation	Criteria
Cooking (boil) energy efficiency	≥ 80%

Energy and Demand Savings Methodology

Savings Calculations and Input Variables

The annual electric energy savings were calculated as the difference between the baseline and ENERGY STAR unit energy consumption (UEC). The inputs for calculating the yearly UEC of a commercial induction cooktop are specified below. The days of operation are calculated from on-site monitored data and survey responses. Commercial cooktop hours of operation were derived from field data from 14 test sites, assuming one boil cycle per hour. The field monitoring sample included quick- and full-service restaurants, hospitality locations, and cafeterias.

[394] ENERGY STAR Commercial Electric Cooktops Version 1.0 Specification: https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Commercial%20Electric%20Cooktops%20Version%201.0%20Specification.pdf.

[395] ENERGY STAR Electric Cooktop Qualified Product Listing. Only induction cooktops are eligible. https://www.energystar.gov/productfinder/product/certified-residential-electric-cooking-products/results.

The deemed values are calculated by using the following algorithms:

$$Energy\ Savings\ [\Delta kWh]\ =\ kWh_{cook,base} - kWh_{cook,ES}$$

Equation 151

Annual kWh_{cook} is calculated in the same way for both the baseline and ENERGY STAR cases, as shown in Equation 152, and peak demand savings are calculated with Equation 153 using their respective input assumptions from Table 211.

$$kWh_{cook}\ =\ kW_{BC} \times N_{boils} \times \frac{t_{boil}}{60} \times DOH \times AOD$$

Equation 152

$$Peak\ Demand\ Savings\ [\Delta kW] = \frac{\Delta kWh}{DOH \times AOD} \times CF$$

Equation 153

Where:

$kWh_{cook,base}$	=	*Baseline cooking/boiling energy consumption [kWh]*
$kWh_{cook,ES}$	=	*ENERGY STAR cooking/boiling energy consumption [kWh]*
kW_{BC}	=	*Energy consumption per boil cycle*
N_{boils}	=	*Estimated number of boils per hour*
t_{boil}	=	*Boil time per cycle [min]*
60	=	*Constant to convert from minutes to hours*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*
CF	=	*Peak coincidence factor*

Table 211. Induction Cooktops—Savings Calculation Inputs and Assumptions[396]

Parameter	Baseline	ENERGY STAR
kW_{BC} (kW)	1.54	2.38
N_{boils}[397]		1
t_{boil} (min)	41.51	23.32
CF[398]		0.90

[396] Input assumptions primarily informed by lab-based equipment performance tests conducted by the SCE FTC and PG&E FSTC.

[397] ENERGY STAR Commercial Food Service Equipment Calculator. https://www.energystar.gov/products/commercial_food_service_equipment.

[398] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

Table 212. Induction Cooktops—Operating Schedule Assumptions[399]

Building Type	DOH	AOD
Education: K-12	6	180
Education: College and university	10	260
All other		326

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings are specified per burner in the following table based on the input assumptions from Table 211.

Table 213. Induction Cooktops—Annual Energy and Peak Demand Savings

Building Type	Energy Savings [kWh]	Peak Demand Savings [kW]
Education: K-12	152	0.13
Education: College and university	366	
All other	459	

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

Currently, no lifetime value is specified for this measure in the California Database of Energy Efficiency Resources (DEER) Remote Ex-Ante Database Interface (READI) tool. The estimated useful life (EUL) is 10 years, as specified in the ENERGY STAR Commercial Food Service Savings Calculator.[383]

Program Tracking Data and Evaluation Requirements

To ensure that the appropriate incentives, savings, and cost-effectiveness values are applied for each application, the following data must be collected for each application:

- Building Type
- Cooktop quantity
- Manufacturer and model number

[399] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility equipment AOD and DOH (if available)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 214. Induction Cooktops—Revision History

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 origin.

2.4.14Induction Soup Wells

TRM Measure ID: NR-FS-SW

Market Sector: Commercial

Measure Category: Appliances

Applicable Building Types: All commercial kitchens, grocery

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

A commercial soup well is an appliance used to maintain hot soups at an appropriate serving temperature throughout the duration of a foodservice facility's operating hours. Certain high powered soup wells known as rethermalizers heat the soup directly in the soup well container prior to holding.

Most soup wells available in the current market use a wet well technology, meaning they are filled with water which is heated to high temperatures. The container holding the soup is then placed in the heated water to maintain temperature. Induction soup wells operate by generating a magnetic field to heat the soup container directly.

Both wet well and induction soup wells are available in 120 V configurations, units featuring multiple wells are available in higher voltages. Soup wells range in holding capacity between 4 and 11 quarts, though the most standard capacities are 7-quart and 11-quart units. There is no current industry standard for evaluating soup well energy consumption and performance.

Eligibility Criteria

Eligible units are defined as electric soup wells that heat product through induction heating.

The following products are excluded from the eligibility criteria:

- Used or rebuilt equipment
- Steam tables
- Resistance heating soup wells

Eligible building types include any nonresidential application.

Baseline Condition

The baseline condition is defined as any electric soup well that does not use induction heating as its primary form of heating, typically using electric resistance heating.

High-Efficiency Condition

The high-efficiency condition is defined as an electric soup well that heats product through induction heating.

In absence of lab testing, eligible products must be included on the current California Energy Wise Foodservice Qualified Product Listing (QPL).[400]

Energy and Demand Savings Methodology

Savings Calculations and Input Variables

The annual electric unit energy saving (UES) is calculated as the difference between the baseline and measure case unit energy consumption (UEC). The daily electric UEC (baseline or measure case) is equal to the average energy rate multiplied by the operational hours per day.

The deemed values are calculated by using the following algorithms:

$$Energy\ Savings\ [\Delta kWh]\ =\ kWh_{avg,base} - kWh_{avg,EE}$$

Equation 154

Where:

$kWh_{avg,base}$ = *Baseline average annual energy consumption [kWh]*

$kWh_{avg,EE}$ = *High-efficiency average annual energy consumption [kWh]*

Annual kWh_{avg} is calculated the same for both the baseline and measure cases, except they require their respective input assumptions relative to operational energy rate as seen in Table 215.

$$kWh_{avg} = E_{avg} \times DOH \times AOD$$

Equation 155

$$Peak\ Demand\ Savings\ [\Delta kW] = \Delta E_{avg} \times CF$$

Equation 156

[400] California Energy Wise Foodservice QPL. https://caenergywise.com/instant-rebates/qpl/. For assistance with qualifying new models, reach out to the California Foodservice Instant Rebates program. https://caenergywise.com/instant-rebates/#contact-us.

Where:

E_{avg}	=	*Average energy rate [kW]*
DOH	=	*Equipment daily operating hours [hr/day]*
AOD	=	*Facility annual operating days [days/year]*
CF	=	*Peak coincidence factor*

Table 215. Induction Soup Wells—Calculation Inputs[401]

Parameter	Variable
$E_{avg,base}$ (kW)	0.188
$E_{avg,EE}$ (kW)	0.104
CF[402]	0.90

Table 216. Induction Soup Wells—Operating Schedule Assumptions[403]

Building type	DOH	AOD
Education: K-12	6	180
Education: College and university	6.9	260
All other		326

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in the following table are based on the input assumptions from Table 215.

Table 217. Induction Soup Wells—Annual Energy and Peak Demand Savings

Building type	Energy savings (kWh)	Peak demand Savings (kW)
Education: K-12	91	0.08
Education: College and university	150	
All other	189	

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

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[401] Input assumptions primarily informed by lab-based equipment performance tests conducted by the SCE FTC and PG&E FSTC.

[402] Itron, Inc., "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study. Final Report." Prepared for Southern California Edison. December 2005. Table 3-14, p. 3-17.

[403] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

There is no estimated useful life (EUL) specifically for commercial soup wells, but its method of operation is similar to that of insulated holding cabinets. Therefore, the EUL is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) Remote Ex-Ante Database Interface (READI) tool for EUL ID Cook-HoldCab.[404]

Program Tracking Data and Evaluation Requirements

To ensure that the appropriate incentives, savings, and cost-effectiveness values are applied for each application, the following data must be collected for each application:

- Building type
- Soup well quantity
- Manufacturer and model number
- Copy of proof of purchase including date of purchase, manufacturer, and model number
- Facility equipment AOD and DOH (if available)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 218. Induction Soup Wells—Revision History

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 origin.

[404] California Public Utilities Commission (CPUC), Energy Division. 2020. https://www.caetrm.com/media/reference-documents/EEPolicyManualRevised_032020.pdf.

2.4.15Demand-Controlled Kitchen Ventilation Measure Overview

TRM Measure ID: NR-FS-KV

Market Sector: Commercial

Measure Category: Food service

Applicable Building Types: All commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Deemed value

Savings Methodology: Algorithms

Measure Description

This measure presents deemed savings for implementation of demand-controlled ventilation (DCV) installed in commercial kitchens. DCV systems make use of control strategies to modulate exhaust fans and make-up air units. Various control strategies may be implemented such as time-of-day scheduling; sensors including exhaust temperature, cook surface temperature, smoke, or steam sensors; or direct communication from cooking equipment to the DCV processor.

Eligibility Criteria

Kitchen ventilation systems both with and without dedicated makeup air units are eligible for this measure. New construction eligibility is limited to kitchens with a total kitchen hood exhaust airflow rate of less than or equal to 5,000 cubic feet per minute (CFM).

Baseline Condition

The baseline condition is a commercial kitchen operating the cooking exhaust and make up air operation at a single fixed speed with on/off controls or operating on an occupancy-based schedule.

Current code includes DCV as a compliance option for kitchens with a total kitchen hood exhaust airflow rate of greater than 5,000 CFM. While there are other compliance options, DCV is most likely. Therefore, new construction applications are ineligible to claim savings when total kitchen hood exhaust airflow rate exceeds this threshold.

High-Efficiency Condition

The efficient condition is a commercial kitchen varying the flow rates of cooking exhaust and make-up air operation based on periods of high and low demand as indicated by schedules or monitors of cooktop operation.

Energy and Demand Savings Methodology

Energy savings are calculated based on monitoring data gathered during field studies conducted by the Food Service Technology Center (FSTC) and published in the ASHRAE Journal.[405] Assumptions for average savings, operating hours and days, and makeup air factors are calculated as the averages for corresponding building types from FSTC monitoring data.

When there is no dedicated makeup air unit, only the exhaust fan power is expected to modulate based on demand and a makeup air unit factor is applied to the savings algorithm. The makeup air unit (MAU) factor is calculated as the percent of total kitchen ventilation system power (exhaust plus makeup air fans) that comes from exhaust fans.

Interactive heating and cooling savings are taken by multiplying the percent airflow savings from the FSTC study by the estimated heating and cooling loads output from the FSTC Outdoor Air Load Calculator (OALC).[406] This output is adjusted by population to account for the percentage of sites with electric resistance or heat pump heating.[407] Additionally, because output from the OALC is per 1,000 CFM, a CFM per HP ratio[408] is applied in order to simplify implementation tracking requirements. Interactive heating and cooling savings are presented per horsepower. Assumed efficiency of AC systems is 10 EER; assumed efficiency of electric resistance heating is 1.0 COP; assumed efficiency of HP heating is 7.7 HSPF.

Savings Algorithms and Input Variables

$$Energy\ Savings\ [\Delta kWh] = HP_{exhaust} \times (IHS + AvgSav_{kWh/HP} \times DOH \times AOD \times MAU)$$

Equation 157

$$Peak\ Demand\ Savings\ [\Delta kW] = \Delta kWh \times CF$$

Equation 158

Where:

$HP_{exhaust}$	=	*Total exhaust horsepower of the kitchen ventilation system included in the DCV operating strategy, facility-specific*
IHS	=	*Interactive heating savings per 1,000 CFM of outdoor air (see Table 220)*
$AvgSav_{kWh/HP}$	=	*Average hourly energy savings per horsepower by building type (see Table 219)*

[405] Fisher, D., Swierczyna, R., and Karas, A. (February 2013) Future of DCV for Commercial Kitchens. *ASHRAE Journal,* 48-53.

[406] Food Service Technology Center Outdoor Air Load Calculator. No longer available online.

[407] Percentage of buildings with electric resistance and heat pump heat are taken from the Energy Information Administration 2018 Commercial Buildings Energy Survey (CBECS), table b.13 Selected Principal Building Activity: Part 2, Number of Buildings. https://www.eia.gov/consumption/commercial/data/2018/.

[408] The CFM per HP ratio was calculated using data from Southern California Edison, ET 07.10 Report on Demand Control Ventilation for Commercial Kitchen Hoods, June 2009.

DOH = *Equipment daily operating hours, facility specific (if unknown, use defaults from Table 219)*

AOD = *Facility annual operating days, facility specific (if unknown use defaults from Table 219)*

MAU = *Make-up air unit factor applied to account for presence of dedicated MAU; value = 1 if there is a dedicated MAU; see Table 219 for values when there is no dedicated MAU*

CF = *Seasonal peak coincidence factor; see Table 221*

Table 219. DCKV—Savings Calculation Input Assumptions

Building type	$AvgSav_{kWh/HP}$	DOH	AOD	MAU with no dedicated MAU
Food service: Full-service restaurant[409]	0.667	15	365	0.65
Food service: Quick-service restaurant[410]				
Food service: 24-hour restaurant[411]	0.631	24	365	0.65
Education: K-12 or college/university with summer session[412]	0.566	11	260	0.51
Education: K-12 without summer session	0.566	11	180	0.51

Table 220. DCKV—Population-Adjusted Interactive HVAC Savings per hp

Climate zone	Building type	Interactive savings (kWh/hp)
Climate Zone 1: Amarillo	Food service: Full-service restaurant	2,666
	Food service: Quick-service restaurant	
	Food service: 24-hour restaurant	6,143
	Education: K-12 or college/university with summer session	2,045
	Education: K-12 without summer session	1,793

[409] Pennsylvania TRM, "3.5.3 High-Efficiency Fan Motors for Walk-In Refrigerated Cases". Page 369, Table 3-93. June 2016.

[410] Ibid.

[411] All values are the average of Hotel Restaurant data from Future of DCV for Commercial Kitchens.

[412] Savings and MAU are calculated as the average of University Dining data from Future of DCV for Commercial Kitchens; Hours per day and Days per year are calculated using operating hours from Table 219.

Climate zone	Building type	Interactive savings (kWh/hp)
Climate Zone 2: Dallas	Food service: Full-service restaurant	2,313
	Food service: Quick-service restaurant	
	Food service: 24-hour restaurant	4,840
	Education: K-12 or college/university with summer session	1,761
	Education: K-12 without summer session	1,331
Climate Zone 3: Houston	Food service: Full-service restaurant	1,996
	Food service: Quick-service restaurant	
	Food service: 24-hour restaurant	4,060
	Education: K-12 or college/university with summer session	1,577
	Education: K-12 without summer session	1,189
Climate Zone 4: Corpus Christi	Food service: Full-service restaurant	1,885
	Food service: Quick-service restaurant	
	Food service: 24-hour restaurant	3,696
	Education: K-12 or college/university with summer session	1,493
	Education: K-12 without summer session	1,063
Climate Zone 5: El Paso	Food service: Full-service restaurant	2,033
	Food service: Quick-service restaurant	
	Food service: 24-hour restaurant	4,522
	Education: K-12 or college/university with summer session	1,579
	Education: K-12 without summer session	1,252

Table 221. DCKV—Seasonal Peak CFs[413]

Climate zone	Summer	Winter
Climate Zone 1: Amarillo	1.33E-04	1.46E-04
Climate Zone 2: Dallas	1.36E-04	1.45E-04
Climate Zone 3: Houston	1.34E-04	1.43E-04
Climate Zone 4: Corpus Christi	1.31E-04	1.45E-04
Climate Zone 5: El Paso	1.45E-04	1.46E-04

[413] CF factors are calculated according to the methods described in TRM Volume 1, Section 4.3. The load shape source is the Pacific Northwest National Laboratory Technical Support Document: 50% Energy Savings for Quick-Service Restaurants, Table B.4, Schedule for Kitchen exhaust flow.

Deemed Energy and Demand Savings Tables

Table 222. DCKV—Energy Savings per hp

Climate zone	Building type	Annual savings (kWh/hp)	
		With dedicated MAU	Without dedicated MAU
Climate Zone 1: Amarillo	Food service: Full-service restaurant	6,311	5,048
	Food service: Quick-service restaurant		
	Food service: 24-hour restaurant	11,667	9,709
	Education: K-12 or college/university with summer session	3,665	2,879
	Education: K-12 without summer session	2,914	2,371
Climate Zone 2: Dallas	Food service: Full-service restaurant	5,958	4,695
	Food service: Quick-service restaurant		
	Food service: 24-hour restaurant	10,364	8,406
	Education: K-12 or college/university with summer session	3,381	2,595
	Education: K-12 without summer session	2,453	1,909
Climate Zone 3: Houston	Food service: Full-service restaurant	5,641	4,378
	Food service: Quick-service restaurant		
	Food service: 24-hour restaurant	9,585	7,627
	Education: K-12 or college/university with summer session	3,197	2,411
	Education: K-12 without summer session	2,310	1,767
Climate Zone 4: Corpus Christi	Food service: Full-service restaurant	5,530	4,266
	Food service: Quick-service restaurant		
	Food service: 24-hour restaurant	9,220	7,263
	Education: K-12 or college/university with summer session	3,113	2,327
	Education: K-12 without summer session	2,185	1,641
Climate Zone 5: El Paso	Food service: Full-service restaurant	5,678	4,415
	Food service: Quick-service restaurant		
	Food service: 24-hour restaurant	10,046	8,089
	Education: K-12 or college/university with summer session	3,199	2,413
	Education: K-12 without summer session	2,374	1,830

Table 223. DCKV—Summer and Winter Peak Demand Savings per hp

Climate zone	Building type	Summer demand savings (kW/hp)		Winter demand savings (kW/hp)	
		With dedicated MAU	Without dedicated MAU	With dedicated MAU	Without dedicated MAU
Climate Zone 1: Amarillo	Food service: Full-service restaurant	0.84	0.67	0.92	0.74
	Food service: Quick-service restaurant				
	Food service: 24-hour restaurant	1.55	1.29	1.71	1.42
	Education: K-12 or college/university with summer session	0.49	0.38	0.54	0.42
	Education: K-12 without summer session	0.39	0.32	0.43	0.35
Climate Zone 2: Dallas	Food service: Full-service restaurant	0.81	0.64	0.86	0.68
	Food service: Quick-service restaurant				
	Food service: 24-hour restaurant	1.41	1.14	1.50	1.22
	Education: K-12 or college/university with summer session	0.46	0.35	0.49	0.38
	Education: K-12 without summer session	0.33	0.26	0.35	0.28
Climate Zone 3: Houston	Food service: Full-service restaurant	0.75	0.59	0.81	0.63
	Food service: Quick-service restaurant				
	Food service: 24-hour restaurant	1.28	1.02	1.37	1.09
	Education: K-12 or college/university with summer session	0.43	0.32	0.46	0.35
	Education: K-12 without summer session	0.31	0.24	0.33	0.25

Climate zone	Building type	Summer demand savings (kW/hp)		Winter demand savings (kW/hp)	
		With dedicated MAU	Without dedicated MAU	With dedicated MAU	Without dedicated MAU
Climate Zone 4: Corpus Christi	Food service: Full-service restaurant	0.73	0.56	0.80	0.62
	Food service: Quick-service restaurant				
	Food service: 24-hour restaurant	1.21	0.95	1.34	1.06
	Education: K-12 or college/university with summer session	0.41	0.31	0.45	0.34
	Education: K-12 without summer session	0.29	0.22	0.32	0.24
Climate Zone 5: El Paso	Food service: Full-service restaurant	0.83	0.64	0.83	0.65
	Food service: Quick-service restaurant				
	Food service: 24-hour restaurant	1.46	1.18	1.47	1.18
	Education: K-12 or college/university with summer session	0.46	0.35	0.47	0.35
	Education: K-12 without summer session	0.35	0.27	0.35	0.27

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 15 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID HVAC-VSD-fan.[414]

[414] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly:

- Climate zone or county
- Building type
- **New construction only:** Total kitchen hood exhaust airflow rate (CFM)
- Kitchen ventilation system exhaust fan horsepower
- Kitchen ventilation makeup air unit fan horsepower, if present
- Presence of dedicated makeup air unit
- Testing and balancing report, if available
- Facility type (Education: K-12, Education: College and university, All other)

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 224. DCKV—Revision History

TRM version	Date	Description of change
v7.0	10/2019	TRM v7.0 origin.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits.
v9.0	10/2021	TRM v9.0 update. Updated EUL reference.
v10.0	10/2022	TRM v10.0 update. Formula updates and corrected table error.
v11.0	10/2023	TRM v11.0 update. Aligned building type names across all commercial measures.
v12.0	10/2024	TRM v12.0 update. Clarified new construction eligibility, specified reduced operating schedule for education applications, corrected heating interactive effects, updated heating type distribution, and updated corresponding deemed savings tables.

2.4.16Pre-Rinse Spray Valves Measure Overview

TRM Measure ID: NR-FS-SV

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Building Types: All commercial kitchens, grocery

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Direct install or point of sale

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure is for the installation of pre-rinse sprayers to reduce hot water usage which, in turn, saves energy associated with heating the water. Water heating is assumed to be electric. The energy and demand savings are determined on a per-sprayer basis and are algorithmically based.

Eligibility Criteria

Units must be used for commercial food preparation only and have flow rates which are no greater than the baseline flow rates specified in Table 225 (on a per product class or spray force in ounce-force (ozf) basis.

Baseline Condition

Effective January 28, 2019, reference baseline equipment is a pre-rinse spray valve (PRSV) with a flow rate that does not exceed the maximum flow rate per product class as specified in Table 225.[415]

Table 225. PRSVs—Flow Rate Limits

Product class (ozf)	Flow rate (gpm)
Product class 1 (≤ 5 ozf)	1.00
Product class 2 (> 5 ozf and ≤ 8 ozf)	1.20
Product class 3 (> 8 ozf)	1.28

[415] Federal Energy Conservation Standard, Code of Federal Regulations, Title 10, Chapter 22, Subchapter D, Part 431, Subpart O, Section §431.266.

High-Efficiency Condition

Following the passing of the Energy Policy Act of 2005, the EPA announced on September 21st, 2005 that it would no longer pursue an ENERGY STAR specification for pre-rinse spray valves.[416] Rather than simply disallowing pre-rinse spray valves altogether, it has been decided that the savings resulting from the retrofitting of this measure be algorithm-based (as opposed to deemed using baseline and high-efficiency assumptions). If identification of a standard flow rate for post-retrofit equipment can be identified, future updates will address the transformation of this measure from an algorithm-based approach to one which is deemed.

The eligible high-efficiency equipment is a pre-rinse spray valve that has a flow rate no greater than the flow rate specified in Table 225 for the pre-rinse spray valve's respective product class. The sprayer should be capable of the same cleaning ability as the old sprayer.[417]

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy and demand savings are calculated using the following algorithms:

$$Energy\ Savings\ [\Delta kWh] = \frac{U \times (F_B - F_P) \times AOD \times (T_H - T_C) \times \rho \times C_P}{RE \times 3{,}412}$$

Equation 159

$$Peak\ Demand\ Savings\ [\Delta kW] = \Delta kWh \times \frac{CF}{100{,}000}$$

Equation 160

Where:

U	=	*Water usage duration (see Table 226)*
F_B	=	*Baseline sprayer flow rate (GPM) (see Table 225)*
F_P	=	*PRSV flow rate (GPM), use actual*
AOD	=	*Facility annual operating days [days/year] (see Table 226)*
T_H	=	*Average mixed hot water (after spray valve) temperature for prewashing [°F] = 120°F*[418]

[416] "Summary of ENERGY STAR Specification Development Process and Rationale for PreRinse Spray Valves". March 2006. https://www.energystar.gov/ia/partners/prod_development/downloads/PRSV_Decision_Memo_Final.pdf?1e37-d3b8.

[417] FEMP Performance Requirements for Federal Purchases of Pre-rinse Spray Valves, Based on ASTM F2324-03: Standard Test Method for Pre-rinse Spray Valves.

[418] "CEE Commercial Kitchens Initiative Program Guidance on Pre-Rince Spray Valves," Consortium of Energy Efficiency (CEE). Page 3. https://library.cee1.org/system/files/library/4252/PRSV%20Program%20Guidance.pdf.

T_C	=	*Average supply (cold) water temperature [°F] = 71.4°F*[419]
ρ	=	*Water density [lbs/gal] = 8.33*
C_P	=	*Specific heat of water [Btu/lb°F] = 1*
RE	=	*Recovery efficiency of an electric water heater = 0.98*[420]
3,412	=	*Constant to convert from Btu to kWh*
CF	=	*Seasonal peak coincidence factor (see Table 227)*
100,000	=	*Constant to convert values for easier readability*

Table 226. PRSVs—Assumed Variables for Energy and Peak Demand Savings Calculations

Variable	Assumed value
U[421]	Food service: Full-service restaurant: 105 min/day/unit Food service: Quick-service restaurant: 45 min/day/unit Office: Cafeteria: 210 min/day/unit Education: K-12: 105 min/day/unit Education: College/university: 210 min/day/unit
AOD[422]	Food service: Full-service restaurant: 360 Food service: Quick-service restaurant: 360 Office: Cafeteria: 360 Education: K-12[423]: 180 Education[424]: College and university: 260

[419] Average calculated input water temperature for five Texas climate zone cities, based on typical meteorological year (TMY) dataset for TMY3: Available at http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

[420] Recovery efficiency of electric water heaters as listed on the AHRI Directory of Certified Product Performance. https://www.ahridirectory.org.

[421] "CEE Commercial Kitchens Initiative Program Guidance on pre-rinse valves", page 3. Midpoint of typical hours of operation in footnoted building types. https://library.cee1.org/system/files/library/4252/PRSV%20Program%20Guidance.pdf.

[422] For facilities that operate year-round: assume operating days of 360 days/year. For dormitories with few occupants in the summer: 360 x (9/12) = 270.

[423] Fisher-Nickel, Inc., "Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Food Service Equipment. Final Project Report." Prepared for the California Energy Commission. October 2014. Appendix E.

[424] Ibid.

Table 227. PRSV—Seasonal Peak CFs[425]

Climate zone	Summer CF			Winter CF		
	Food service: Full-service restaurant and cafeterias[426]	Food service: Quick-service restaurant	Education: K-12	Food service: Full-service restaurant and cafeterias[427]	Food service: Quick-service restaurant	Education: K-12
Climate Zone 1: Amarillo	3.151	6.298	2.537	5.026	6.205	0.666
Climate Zone 2: Dallas	4.767	5.850	2.630	4.279	5.868	0.899
Climate Zone 3: Houston	3.544	6.237	2.627	3.219	5.015	1.556
Climate Zone 4: Corpus Christi	3.092	6.214	2.768	5.462	6.754	1.561
Climate Zone 5: El Paso	6.805	5.660	3.934	7.063	8.490	0.000

Deemed Energy and Demand Savings Tables

There are no deemed energy or demand savings tables for this measure. Please see the High-Efficiency Condition section for the rationale used in opting for an algorithm-based approach.

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 5 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID Cook-LowPreRinse.[428]

[425] CFs are developed according to the method described in the Texas TRM Volume 1, using load profiles derived from the American Society of Heating Refrigeration and Air-Conditioning Engineers, Inc., ASHRAE Handbook 2019. HVAC Applications. Chapter 50 51 - Service Water Heating, Section 9 – Hot Water Load and Equipment Sizing, Figure 24 – Hourly Flow Profiles for Various Building Types. CF values are multiplied by 100,000 to allow for easier readability of the values.

[426] This building type should be used for Food Service: Full-service restaurant, Office: Cafeteria, and Education: College/university cafeteria.

[427] Ibid.

[428] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly.

- Climate zone or county
- Spray force in ounce-force (ozf)
- Baseline equipment flow-rate
- Retrofit equipment flow-rate
- Building type

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 40669—Provides energy and demand savings and measure specifications. Attachment A: https://interchange.puc.texas.gov/Documents/40669_3_735684.PDF.
- PUCT Docket 36779—Provides EUL for pre-rinse sprayers

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 228. PRSVs—Revision History

TRM version	Date	Description of change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. Updated the baseline and post-Retrofit minimum flow rate values, based on federal standards. Removed reference to a list of qualifying pre-rinse spray valves.
v3.0	04/10/2015	TRM v3.0 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits.

TRM version	Date	Description of change
v9.0	10/2021	TRM v9.0 update. General reference checks, updates to input assumptions, and update peak demand savings. Updated EUL reference.
v10.0	10/2022	TRM v10.0 update. Formula and variable definition updates.
v11.0	10/2023	TRM v11.0 update. Adjusted mixed water hot temperature to match CEE guidance. Aligned building type names across all commercial measures.
v12.0	10/2024	TRM v12.0 update. Specified reduced operating schedule for education applications.

2.4.17Vacuum-Sealing and Packaging Machines Measure Overview

TRM Measure ID: NR-MS-VS

Market Sector: Commercial

Measure Category: Miscellaneous

Applicable Building Types: Supermarket, Grocery, Commercial kitchens

Fuels Affected: Electricity

Decision/Action Type: Retrofit, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: M&V

Measure Description

This measure involves the replacement of always-on commercial electric vacuum-sealing and packaging machines with on-demand commercial electric vacuum-sealing and packaging machines. Packaging machines consist of a heating bar and heating platform. The heating bar is used to cut the wrapping film as it meets the heating bar. The heating platform is used to heat up the wrapping film. When the wrapping film is heated, the film sticks to the package and seals the product.

Eligibility Criteria

Eligible vacuum-sealing and packaging machines must use either a mechanical or optical control system. A mechanical system applies downward pressure onto a larger heating element platform, engaging a switch that activates a heating element until the switch is disengaged (or for a maximum of three seconds). An optical system uses an optical eye to detect that an item is being sealed. The eye is placed in the front center of a large heating element. When a package is set on the heating element, light is reflected into the eye, engaging the heating element until it is removed (or for a maximum of three seconds).

The measure is restricted to supermarket, grocery, and other food store building types.

Baseline Condition

The baseline is a conventional (always-on) packaging machine. With conventional machines, both heating elements are kept at a constant temperature of 280°F.

High-Efficiency Condition

The high-efficiency condition is an on-demand packaging machine. On-demand machines are similar but have a more powerful heating platform, which defaults to off and is switched on/off by a controller.

Savings Algorithms and Input Variables

Southern California Edison (SCE) and the Food Service Technology Center (FSTC) conducted a field study to evaluate and compare energy savings and demand reduction potential between baseline and on-demand package sealers in supermarkets.[429] The study included four supermarket chains, with three sites selected for each chain. Each test site operated approximately 20 hours per day. Package sealers were located in deli, meat, and or produce departments. Power data was measured in 10-second intervals over a six-week monitoring period. A low sample interval was chosen to accurately capture the pulsing of the heating elements.

The study estimated demand savings by averaging power draw during the peak hours from 2-5 PM to account for the cycling of the larger heating element on the on-demand unit. This measure uses 10-minute average load shape to estimate coincidence factors consistent with the Texas peak definition.[430] This approach is more consistent with the 15-minute interval data typically used in calculated demand and energy charges by utilities. Demand savings are calculated by dividing energy savings by 8,760 and multiplying against the coincidence factor.

Deemed Energy and Demand Savings Tables

Table 229. Vacuum-Sealing & Packaging Machines—Energy and Peak Demand Savings

Building type	kWh/machine	Summer kW/ machine	Winter kW/ machine
Supermarkets, grocery, and food stores	1,568	0.06	0.06

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for vacuum-sealing and packaging machines is 10 years, based on the University of California Useful Life Indices.[431]

[429] "Vacuum-Sealing and Packaging Machines for Food Service Field Test, ET13SCE1190 Report," SCE & FTSC. December 2014. https://www.etcc-ca.com/sites/default/files/reports/ET10SCE1450%20Vacuum%20Sealing%20Packaging%20Machine%20Report_Final.pdf.

[430] See Volume 1, Section 4.

[431] "Useful Life Indices for Equipment Depreciation", University of California Office of the President. https://eulid.ucop.edu/.

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data is recommended to be specified and tracked by the program database to inform the evaluation and apply the savings properly.

- Building type
- Number of packaging machines
- Packaging machine manufacturer and model

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 230. Vacuum-Sealing & Packaging Machines—Revision History

TRM version	Date	Description of change
v8.0	10/2020	TRM v8.0 origin.
v9.0	10/2021	TRM v9.0 update. No revision.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v12.0 update. No revision.

2.4.18 Hand Wrap Machines Measure Overview

TRM Measure ID: NR-FS-HW

Market Sector: Commercial

Measure Category: Food service equipment

Applicable Building Types: Supermarket, grocery, commercial kitchens

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit,

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

A commercial hand-wrap machine is an appliance used to wrap and seal food items before being displayed for purchase. A hand-wrap machine consists of a heating bar and a heating platform, rated at approximately 0.05 kW and 0.55 kW, respectively. The heating bar cuts the wrapping film as it comes in contact with itself. The heating platform heats up the wrapping film. When the wrapping film is heated, the film sticks to the package and seals the product. Both heating elements of the conventional (always on) hand-wrap machine are kept at a constant temperature of 280°F.

An on-demand (OD) hand-wrap machine has a more powerful heating platform (rated at approximately 2 kW), which is switched ON/OFF by a controller. Mechanical systems engage a switch when pressure is applied to the heating platform, which activates the heating platform until the switch is disengaged or for a maximum of three seconds. Alternatively, optical systems feature an optical eye to detect that an item is being sealed. When a package is set on the heating platform, light is reflected into the eye, which activates the heating platform until the item is removed or for a maximum of three seconds.

Measure savings result from eliminating standby losses. Although an OD hand-wrap machine has a more powerful heating element than the always-on machine (2 kW compared to 0.55 kW), the total hours of operation are much less.

Eligibility Criteria

Eligible units are defined as new commercial OD hand-wrap machines that use either a mechanical or optical control system. Used or rebuilt hand-wrap machines are not eligible.

Eligible building types include any nonresidential application.

Baseline Condition

The baseline condition is an always-on commercial electric hand-wrap machine.

Generally, new construction is ineligible to claim savings under this measure. However, utilities may work with the EM&V team to determine the baseline standard for new construction applications, if applicable.

High-Efficiency Condition

The high-efficiency condition is a new commercial on-demand hand-wrap machine.

Energy and Demand Savings Methodology

Savings Calculations and Input Variables

The annual electric unit energy saving (UES) of this measure were derived from a 2015 field test study conducted by Southern California Edison (SCE) through the Emerging Technologies Program.[432] The SCE field test monitored hand wrap machines in the bakery, deli, and meat departments at four supermarket chains across 21 supermarket locations. Both baseline and high-efficiency condition hand wrap machines were monitored for six weeks at ten-second intervals. For each chain, an average unit energy consumption (UEC) was calculated for units in bakery and deli departments, and a separate average UEC was calculated for units in meat departments. The average UEC values for each use type were then averaged together to calculate the overall average UEC and peak demand.

The deemed values are calculated by using the following algorithms:

$$Energy\ Savings\ [\Delta kWh]\ =\ kWh_{avg,base} - kWh_{avg,OD}$$

Equation 161

$$Peak\ Demand\ Savings\ [\Delta kW] = kW_{avg,base} - kW_{avg,OD}$$

Equation 162

Where:

$kWh_{avg,base}$	=	*Weighted average baseline annual energy consumption [kWh]*
$kWh_{avg,OD}$	=	*Weighted average OD annual energy consumption [kWh]*
$kW_{avg,base}$	=	*Weighted average baseline peak demand energy rate [kW]*
$kW_{avg,OD}$	=	*Weighted average OD peak demand energy rate [kW]*

[432] "Emerging Products: Commercial Hand Wrap Machines for Food Service Applications Field Test, ET13SCE1190". Southern California Edison (SCE). October 2015. https://www.caetrm.com/media/reference-documents/SCE_2014_ET13SCE1190_Report.pdf.

Annual kWh_{avg} is calculated the same for both the baseline and efficiency cases, except they require their respective input assumptions relative to measured field data values seen in Table 231.

$$kWh_{avg} = \left(\frac{\sum_{i=1}^{4}\left(kWh_{chain,i} \times N_{HWM,i}\right)}{\mathrm{N}_{HWM}}\right)$$

Equation 163

$$kW_{avg} = \left(\frac{\sum_{i=1}^{4}\left(kW_{chain,i} \times N_{HWM,i}\right)}{\mathrm{N}_{HWM}}\right)$$

Equation 164

Where:

$kWh_{chain,i}$ = *Measured annual energy consumption [kWh]*

$kW_{chain,i}$ = *Measured peak demand energy rate [kW]*

$N_{HWM,i}$ = *Number of measured hand wrap machines per supermarket chain*

N_{HWM} = *Total number of measured hand wrap machines*

Table 231. Hand Wrap Machines—Savings Calculation Input Assumptions

Supermarket chain	# Chains	Base kWh	OD kWh	Base kW	OD kW
1	6	2,311	412	0.27	0.05
2	7	1,810	395	0.23	0.04
3	6	1,697	452	0.27	0.05
4	2	1,983	361	0.23	0.04
Total/average	**21**	**1,937**	**413**	**0.253**	**0.046**

Deemed Energy and Demand Savings Tables

Deemed energy and demand savings in the following table are based on the input assumptions from Table 231.

Table 232 Hand Wrap Machines—Annual Energy and Peak Demand Savings

Energy savings (kWh)	Peak demand savings (kW)
1,524	0.207

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Additional Calculators and Tools

Not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is ten years for EUL ID FoodHandWrap.[433]

Program Tracking Data and Evaluation Requirements

To ensure that the appropriate incentives, savings, and cost-effectiveness values are applied for each application, the following data must be collected for each application:

- Machine quantity
- Manufacturer and model number
- Copy of proof of purchase including date of purchase, manufacturer, and model number

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 233. Hand Wrap Machines —Revision History

TRM version	Date	Description of change
v12.0	10/2024	TRM v12.0 origin.

[433] "Useful Life Index, G8605: Cutters, Slicers, Saws, Choppers, Graters, Grinders, Universal Mach, Food Prep." University of California, Office of the President, Purchasing Services. 2018. https://www.ucop.edu/procurement-services/for-ucstaff/equipment-management.html.

2.5 NONRESIDENTIAL: REFRIGERATION

2.5.1 Door Heater Controls Measure Overview

TRM Measure ID: NR-RF-HC

Market Sector: Commercial

Measure Category: Refrigeration

Applicable Building Types: Any commercial retail facility such as supermarkets, grocery stores, hotels, restaurants, and convenience stores.

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the deemed savings methodology for the installation of door heater controls for glass-door refrigerated cases with anti-sweat heaters (ASH). A door heater controller senses dew point (DP) temperature in the store and modules power supplied to the heaters accordingly. DP inside a building is primarily dependent on the moisture content of outdoor ambient air. Because the outdoor DP varies between climate zones, weather data from each climate zone must be analyzed to obtain a DP profile. The reduced heating results in a reduced cooling load. The savings are on a per-horizontal-linear-foot-of-display-case basis.

Eligibility Criteria

The efficient equipment must be a standard-heat configuration door heater control utilized in an eligible commercial retail facility on glass-door refrigerated cases for the purpose of dynamically controlling humidity.

Baseline Condition

The baseline efficiency case is a cooler or a freezer door heater that operates 8,760 hours per year without any controls.

High-Efficiency Condition

Eligible high efficiency equipment is a cooler or a freezer door heater connected to a heater control system, which controls the door heaters by measuring the ambient humidity and temperature of the store, calculating the dew point (DP) temperature, and using pulse width modulation to control the anti-sweat door heater based on specific algorithms for freezer and cooler doors.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

The energy savings from the installation of anti-sweat heater controls are a result of both the decrease in length of time the heater is running (kWh_{ASH}) and the reduction in load on the refrigeration (kWh_{refrig}). These savings are calculated using the following procedures:

Indoor dew point ($T_{d\text{-}in}$) can be calculated from outdoor dew point ($T_{d\text{-}out}$) per climate zone using the following equation:

$$T_{d-in} = 0.005379 \times T_{d-out}^2 + 0.171795 \times T_{d-out} + 19.87006$$

Equation 165[434]

The baseline assumes door heaters are running on an 8,760-hour operating schedule. In the post-retrofit case, the duty for each hourly reading is calculated by assuming a linear relationship between indoor DP and duty cycle for each bin reading. It is assumed that the door heaters will be all off (duty cycle of 0%) at 42.89°F DP and all on (duty cycle of 100%) at 52.87°F DP for a typical supermarket.[435] Between these values, the door heaters' duty cycle changes proportionally:

$$Door\ Heater\ ON\% = \frac{T_{d-in} - All\ OFF\ setpt\ (42.89°F)}{All\ ON\ setpt\ (52.87°\text{F}) - All\ OFF\ setpt\ (42.89°F)}$$

Equation 166

[434] San Diego Gas & Electric, Work Paper WPSDGENRRN0009: Anti-Sweat Heat (ASH) Controls, "Energy Savings Estimation Methodologies". page 4, Figure 2. August 2012. https://www.sdge.com/sites/default/files/WPSDGENRRN0009%2520Rev%25200%2520Anti-Sweat%2520Heat%2520%2528ASH%2529%2520Controls%2520_0.doc.

[435] Ibid, "Direct ASH Power", page 6.
42.89°F DP and 52.87°F DP correspond to relative humidity of 35 percent and 50 percent, respectively, for a 72°F indoor space. These relative humidity values are common practice setpoints for a typical supermarket of this temperature.

The controller only changes the run-time of the heaters, so the instantaneous door heater power (kW_{ASH}) as a resistive load remains constant per linear foot of door heater[436] at:

For medium temperature (coolers):

$$kW_{ASH} = 0.109 \text{ per door or } 0.0436 \text{ per horizontal linear foot of door}^{437}$$

Equation 167

For low temperature (freezers):

$$kW_{ASH} = 0.191 \text{ per door or } 0.0764 \text{ per horizontal linear foot of door}^{438}$$

Equation 168

Door heater energy consumption for each hour of the year is a product of power and run time:

$$kWh_{ASH-Hourly} = kW_{ASH} \times Door\ Heater\ ON\% \times 1Hour$$

Equation 169

$$kWh_{ASH} = \sum kWh_{ASH-Hourly}$$

Equation 170

To calculate energy savings from the reduced refrigeration load using average system efficiency and assuming that 35 percent of the anti-sweat heat becomes a load on the refrigeration system,[439] the cooling load contribution from door heaters for each hour of the year can be given by:

$$Q_{ASH}(ton-hrs) = 0.35 \times kW_{ASH} \times \frac{3{,}412\frac{Btu}{hr}}{12{,}000\frac{Btu}{ton}} \times Door\ Heater\ ON\%$$

Equation 171

The compressor power requirements are based on calculated cooling load and energy-efficiency ratios obtained from manufacturers' data. The compressor analysis is limited to the cooling load imposed by the door heaters, not the total cooling load of the refrigeration system.

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[436] Pennsylvania TRM, "3.5.6 Controls: Anti-Sweat Heater Controls". page 381, Table 3-101. June 2016. http://www.puc.pa.gov/pcdocs/1350348.docx. Additional reference from Pennsylvania TRM: State of Wisconsin, Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs Deemed Savings Manual. Table 4-75., March 22, 2010. https://focusonenergy.com/sites/default/files/bpdeemedsavingsmanuav10_evaluationreport.pdf.

[437] Ibid.

[438] Ibid.

[439] A Study of Energy Efficient Solutions for Anti-Sweat Heaters. Southern California Edison RTTC. December 1999.

For medium temperature refrigerated cases, the saturated condensing temperature (SCT_{MT}) is calculated as the design dry-bulb temperature plus 15 degrees. For low-temperature refrigerated cases, the SCT_{LT} is the design dry-bulb temperature plus 10 degrees. The EER for both medium- and low-temperature applications is a function of SCT and part load ratio (PLR) of the compressor. PLR is the ratio of total cooling load to compressor capacity and is assumed to be a constant of 1/1.15 or approximately 0.87.[440]

For medium temperature compressors, the following equation is used to determine EER_{MT} [Btu/hr/watts] for each hour of the year:

$$EER_{MT} = a + (b \times SCT) + (c \times PLR) + (d \times SCT^2) + (e \times PLR^2) + (f \times SCT \times PLR) + (g \times SCT^3) + (h \times PLR^3) + (i \times SCT \times PLR^2) + (j \times SCT^2 \times PLR)$$

Equation 172[441]

Where:

a	=	*3.75346018700468*
b	=	*-0. 049642253137389*
c	=	*29.4589834935596*
d	=	*0.000342066982768282*
e	=	*-11.7705583766926*
f	=	*-0.212941092717051*
g	=	*-1.46606221890819 x 10^{-6}*
h	=	*6.80170133906075*
I	=	*-0.020187240339536*
j	=	*0.000657941213335828*
PLR	=	*1/1.15 = 0.87*
SCT	=	*T_{db} + 15*
T_{DB}	=	*Dry-bulb temperature*

[440] Work Paper PGEREF108: Anti-Sweat Heat (ASH) Controls. Pacific Gas and Electric Company. May 29,2009. Assumes 15% oversizing.

[441] San Diego Gas & Electric, Work Paper WPSDGENRRN0009: Anti-Sweat Heat (ASH) Controls, "Energy Savings Estimation Methodologies". page 4, Figure 2. August 2012. https://www.sdge.com/sites/default/files/WPSDGENRRN0009%2520Rev%25200%2520Anti-Sweat%2520Heat%2520%2528ASH%2529%2520Controls%2520_0.doc.

For low temperature compressors, the following equation is used to determine the EER_{LT} [Btu/hr/watts] for each hour of the year:

$$EER_{LT} = a + (b \times SCT) + (c \times PLR) + (d \times SCT^2) + (e \times PLR^2) + (f \times SCT \times PLR) + (g \times SCT^3) + (h \times PLR^3) + (i \times SCT \times PLR^2) + (j \times SCT^2 \times PLR)$$

Equation 173[442]

Where:

a	=	*9.86650982829017*
b	=	*-0.230356886617629*
c	=	*22.905553824974*
d	=	*0.00218892905109218*
e	=	*-2.48866737934442*
f	=	*-0.248051519588758*
g	=	*-7.57495453950879 x 10^{-6}*
h	=	*2.03606248623924*
i	=	*-0.0214774331896676*
j	=	*0.000938305518020252*
PLR	=	*1/1.15 = 0.87*
SCT_{LT}	=	T_{db} *+10*
T_{DB}	=	*Dry-bulb temperature*

Energy used by the compressor to remove heat imposed by the door heaters for each hourly reading is determined based on calculated cooling load and EER, as outlined below:

$$kWh_{refrig-hourly} = Q_{ASH} \times \frac{12}{EER}$$

Equation 174

$$kWh_{refrig} = \sum kWh_{refrig-Hourly}$$

Equation 175

Total annual energy consumption (direct door heaters and indirect refrigeration) is the sum of both annual kWh consumption variables:

$$kWh_{total} = kWh_{refrig} + kWh_{ASH}$$

Equation 176

[442] Ibid.

Total energy savings is the difference between the baseline and post-retrofit case:

$$Energy\ Savings\ [\Delta kWh] = kWh_{total-baseline} - kWh_{total-post}$$

Equation 177

Peak demand savings are calculated as the weighted average of the probability of winter or summer peak load's top twenty hours' coincidence with system peak and the hourly calculated kWh_{total} for said twenty hours per climate zone.

Deemed Energy and Demand Savings Tables

The energy and demand savings of anti-sweat door heater controls are deemed values based on city/climate zone and refrigeration temperature, with hourly dry-bulb temperatures and outdoor dew points determined using TMY3 Hourly Weather Data by Climate Zone;[443] Table 234 provides these deemed values. Savings are specified per horizontal linear feet of door.

Table 234. Door Heater Controls—Energy and Peak Demand Savings per Lin. Ft. of Door

Climate zone	Medium temperature		Low temperature	
	Energy savings (kWh/ft)	Peak demand savings (kW/ft)	Energy savings (kWh/ft)	Peak demand savings (kW/ft)
Climate Zone 1: Amarillo	342	0.047	610	0.081
Climate Zone 2: Dallas	232	0.047	413	0.081
Climate Zone 3: Houston	170	0.047	304	0.082
Climate Zone 4: Corpus Christi	131	0.047	234	0.083
Climate Zone 5: El Paso	380	0.047	682	0.084

Claimed Peak Demand Savings

Refer to Volume 1, Section 4 for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 12 years, as specified in the California Database of Energy Efficiency Resources (DEER) READI tool for EUL ID GrocDisp-ASH.[444]

[443] http://texasefficiency.com/index.php/regulatory-filings/deemed-savings
[444] DEER READI (Remote Ex-Ante Database Interface). http://www.deeresources.com/index.php/readi.

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data should be specified and tracked within the program database to inform the evaluation and apply the savings properly:

- Climate zone or county
- Refrigeration temperature (medium, low)
- Linear feet of door length

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 40669—Provides energy and demand savings and measure specifications. Attachment A: https://interchange.puc.texas.gov/Documents/40669_7_736774.PDF. https://interchange.puc.texas.gov/Documents/40669_7_736775.PDF.
- PUCT Docket 36779—Provides EUL for Anti-Sweat Heater Controls

Relevant Standards and Reference Sources

Please refer to measure citations for relevant standards and reference sources.

Document Revision History

Table 235. Door Heater Controls—Revision History

TRM version	Date	Description of change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. In the energy savings equation used to determine the EER, rounded off the regression coefficients to 4 or 5 significant figures.
v2.1	01/30/2015	TRM v2.1 update. Correction to state that savings are on a per-linear foot of display case.
v3.0	04/10/2015	TRM v3.0 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. Update Deemed kW_{ASH} for Medium temperature cases and add kW_{ASH} for Low-temperature cases. Added more significant digits to the input variables a-j for Equation 172 and Equation 173.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	10/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.
v8.0	10/2020	TRM v8.0 update. General reference checks and text edits.

TRM version	Date	Description of change
v9.0	10/2021	TRM v9.0 update. Updated peak demand methodology to follow Volume 1 methods. Changed Zone 4 reference location from McAllen to Corpus Christi. Updated EUL reference.
v10.0	10/2022	TRM v10.0 update. No revision.
v11.0	10/2023	TRM v11.0 update. No revision.
v12.0	10/2024	TRM v11.0 update. No revision.

2.5.2 ECM Evaporator Fan Motors Measure Overview

TRM Measure ID: NR-RF-FM

Market Sector: Commercial

Measure Category: Refrigeration

Applicable Building Types: Any commercial retail facility such as supermarkets, grocery stores, hotels, restaurants, convenience stores, and schools[445]

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the algorithm methodology for the replacement of existing evaporator fan motors with electronically commutated motors (ECMs) in cooler and freezer display cases. ECMs can provide up to 65 percent reduction in fan energy use with higher efficiencies, automatic variable-speed drive, lower motor operating temperatures, and less maintenance.

Eligibility Criteria

All ECMs must be suitable, size-for-size replacements of evaporator fan motors.

Baseline Condition

The baseline efficiency case is an existing shaded pole (SP) or permanent slit capacitor (PSC) evaporator fan motor in a refrigerated case.

High-Efficiency Condition

Eligible high-efficiency equipment is an electronically commutated motor which replaces an existing evaporator fan motor.

[445] Refrigeration and freezer units utilized in a school setting typically function year-round. This operating schedule prevents malfunctioning due to periods of prolonged disuse and allows child nutrition meal programs offered to students and the community to operate during school off-seasons. Schools are therefore an applicable building type for this measure, which utilizes annual operating hours derived from a full-year schedule.