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FOOD SERVICE

CONVEYOR TOASTER, COMMERCIAL

SWFS023 - 01

CONTENTS

MEASURE NAME

Conveyor Toaster, Commercial

STATEWIDE MEASURE ID

SWFS023-01

TECHNOLOGY SUMMARY

A conveyor toaster is an appliance that caramelizes and carries bread products on a belt or chain into and through a heated chamber. Conveyor contact toasters are used in high volume, sandwich bun toasting applications. Contact toasters use resistance heating elements integrated into heavy metal plates, called a "platen." The cut sides of a hamburger bun are pressed against the heated platen by a moving conveyor belt. The width of this conveyor belt can differ between models to toast multiple buns simultaneously, which can affect production capacity. The toasters can be oriented either vertically or horizontally.

The design features of high performance conveyor toaster (HPCT) vary and can include an internal radiative ambient air heater, heat shields, and dampers at the openings to achieve desired capacity production and energy use per sandwich rates. (For clarification, a sandwich consists of a crown piece and a heel piece. For the purpose of this paper, the word "bun" is interchangeable with the word "sandwich".) Manufacturers might also include variable levels of adjustment to the platen temperature, ambient heater temperature, and belt speed. The combination of adjustable features, insulative design elements, as well as time and energy used while cooking and recovering from cooking will result in different energy consumption during daily operation.

Figure 1: One- Lane High Performance Conveyor Toaster

MEASURE CASE DESCRIPTION

The measure case specification was developed from lab-based equipment performance tests (following the test procedures of ASTM F2380-18) conducted by the Pacific Gas & Electric (PG&E) Food Service Technology Center (FSTC) and the Southern California Edison (SCE) Foodservice Technology Center (FTC).[1]

The measure case is defined as a high performance conveyor toaster with an energy per sandwich less than or equal to 3.75 W/bun.

Energy per Sandwich is a function of the cooking energy rate and the production capacity.

$$\textbf{Energy per Sandwich} = \frac{cooking\ energy\ rate\ x\ WattKW}{production\ capacity}$$

cooking energy rate =	*measured energy rate during cooking mode (kW)*
production capacity =	*number of sandwiches a unit can cook per hour (buns/hour)*
WattKW =	*constant – 1000 watts per kilowatt (W/kW)*

BASE CASE DESCRIPTION

Since commercial conveyor toasters are not covered by state or national codes, there is little incentive for equipment manufacturers to test their baseline equipment. Therefore, the base case efficiency for existing models was determined from a sample of economy-grade equipment tested by the Southern California Edison (SCE) Foodservice Technology Center (FTC).

The base case is defined as a standard performance conveyor toaster with an energy per sandwich greater than 3.75 W/Bun.

CODE REQUIREMENTS

Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20	None.	n/a
CA Building Energy Efficiency Standards – Title 24	None.	n/a
Federal Standards	None.	n/a

Conveyor Toaster performance is determined by applying the American Society for Testing and Materials (ASTM) Standard Test Method for Performance of Conveyor Toasters F2380-18, the industry standard for quantifying the efficiency and performance of conveyor toasters.

[1] Southern California Edison (SCE) Foodservice Technology Center (FTC). 2020. "SWFS023-01 Conveyor Toaster, Commercial - Lab Testing Data.xlsx."

NORMALIZING UNIT

Each (conveyor toaster)

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

All combinations of measure application type, delivery type, and sector that are established for this measure are specified below. Measure application type is a categorization based on the circumstances and timing of the measure installation. Each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.

Implementation Eligibility

Measure Application Type	Delivery Type	Sector
Normal Replacement	UpDeemed	Commercial
Normal Replacement	DnDeemed	Commercial
Normal Replacement	DnDeemDI	Commercial
New Construction	UpDeemed	Commercial
New Construction	DnDeemed	Commercial
New Construction	DnDeemDI	Commercial

Eligible Products

To qualify as a high performance conveyor toaster, the unit must meet the energy per sandwich requirement specified in the Measure Case Description.

Eligible Building Types and Vintages

This measure is applicable to any commercial building type of any vintage.

Eligible Climate Zones

This measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

Used or rebuilt equipment is not eligible.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

Food Service (FoodServ)

ELECTRIC SAVINGS (KWH)

Methodology

The annual electric unit energy savings (UES) is calculated as the difference between the baseline and measure case unit energy consumption (UEC).

Annual Electric Unit Energy Consumption

The daily electric UEC (baseline or measure case) is equal to the sum of the energy required for cooking, preheat, and idle modes of toaster operation. These calculations and the inputs are provided below.

$$\boldsymbol{UEC\_day} = cooking\ energy + preheat\ energy + idle\ energy$$

Cooking energy is a function of the cooking energy rate, the number of sandwiches cooked per day, and the production capacity.

$$\boldsymbol{cooking\ energy} = cooking\ energy\ rate\ x\ \frac{total\ sandwiches\ cooked\ per\ day}{production\ capacity}$$

cooking energy rate =	*measured energy rate during cooking mode (kW)*
total sandwiches cooked per day =	*estimated number of sandwiches cooked per unit per day (buns)*
production capacity =	*number of sandwiches a unit can cook per hour (buns/hour)*

Preheat energy is a function of the preheat energy rate, the number of preheats per day, and the time required for each preheat cycle.

$$\boldsymbol{preheat\ energy} = preheat\ energy\ rate\ x\ number\ of\ preheats\ x\ \frac{preheat\ time}{MinHr}$$

preheat energy rate =	*measured energy rate during preheat mode (kW)*
number of preheats =	*estimated number of preheats per day*
preheat time =	*estimated preheat time (min)*
MinHr =	*constant – 60 minutes per hour (min/hr)*

Idle energy is a function of the idle energy rate, operating hours per day, the number of sandwiches cooked per day, the production capacity, the number of preheats per day, and the time required for each preheat cycle.

$$\boldsymbol{idle\ energy} = idle\ energy\ rate\ x \left[work\ hours\ per\ day - \frac{total\ buns\ cooked\ per\ day}{production\ capacity} - \left(number\ of\ preheats\ x\ \frac{preheat\ time}{MinHr}\right)\right]$$

idle energy rate =	*measured energy rate during idle mode (kW)*
work hours per day =	*estimated working hours per day (hours)*
total sandwiches cooked per day =	*estimated number of sandwiches cooked per unit per day (buns)*
production capacity =	*number of sandwiches a unit can cook per hour (buns/hour)*
number of preheats =	*estimated number of preheats per day*
preheat time =	*estimated preheat time (min)*
MinHr =	*constant – 60 minutes per hour (min/hr)*

The **annual UEC** is calculated as the daily UEC multiplied by the operating days per year.

$$\boldsymbol{UEC\_year} = UEC\_day\ x\ work\ days\ per\ year$$

UEC_year =	*annual unit energy consumption (kWh/year)*
UEC_day =	*daily unit energy consumption (kWh/day)*
workdays per year =	*estimated working days per year (days/year)*

Annual Electric Unit Energy Savings

The **annual UES** is calculated as the difference between the baseline and measure case annual UEC.

$$\boldsymbol{UES\_year} = UEC\_year_{base} - UEC\_year_{measure}$$

UES_year =	*annual unit energy savings (kWh)*
UEC_year_{base} =	*annual baseline unit energy consumption (kWh/year)*
$UEC\_year_{measure}$ =	*annual measure unit energy consumption (kWh/year)*

Inputs and Assumptions

The inputs for the calculation of the annual UES of a conveyor toaster are specified below. The base case model values represent the average values of toasters tested by the SCE FTC with energy per sandwich greater than 3.75 W/bun, thus classified as a standard performance conveyor toaster. The measure case model values represent the average values of toasters tested by the SCE FTC with energy per sandwich less than or equal to 3.75 W/bun, thus classified as a high performance conveyor toaster.

Parameter	Base Case Model	Measure Case Model	Source
Cooking Energy Rate (*kW*)	2.0412	2.0633	Southern California Edison. 2020. *High-Performance Conveyorized Toaster.* Emerging Technologies project ET18SCE1120. Southern California Edison (SCE) Foodservice Technology Center (FTC). 2020. "SWFS023-01 Convey Toaster, Commercial - Lab Testing Data.xlsx."
Production Capacity (*buns/hr*)	338	698	
Energy per Sandwich (*W/bun*)	6.0981	2.9535	
Preheat Energy Rate (*kW*)	2.3288	2.1196	
Number of Preheats	1	1	
Preheat Time (*min*)	21.4208	9.8267	
Idle Energy Rate (*kW*)	0.9822	0.6400	
Total Sandwich Cooked Per Day (*buns*)	650	650	Livchak, D. and R. Swierczyna. 2012. *Roundup VCT-2000CV Appliance Test Report (Report No. 501311102-R0)*. February.
Work Hours Per Day (*hours*)	16	16	
Workdays Per Year (*days/year*)	364	364	

A sample calculation of the daily and annual UEC of a base case conveyor toaster is provided below.

$$\boldsymbol{cooking\ energy} = 2.0412\ x\ \frac{650}{338} = 3.9254\ kWh$$

$$\boldsymbol{preheat\ energy} = 2.3288\ x\ 1\ x\ \frac{21.4208}{60} = 0.8314\ kWh$$

$$\boldsymbol{idle\ energy} = 0.9822\ x \left[16 - \frac{650}{338} - \left(1\ x\ \frac{21.4208}{60}\right)\right] = 13.7200\ kWh$$

$$\boldsymbol{UEC\_day} = 3.9254 + 0.8314 + 13.7200\ = 18.4768\ kWh/day$$

$$\boldsymbol{UEC_{year}} =\ 18.4768\ x\ 364 = 6725.5552\ kWh/year$$

PEAK ELECTRIC DEMAND REDUCTION (KW)

Methodology

The actual contribution to peak demand may vary significantly depending on the toaster's usage pattern in relation to that of other electric equipment in the facility (operating schedule, appliance ON time, etc.). The probability of an appliance drawing its average rate during the period of the building peak is significantly higher than for any other input rate for that appliance.

Peak Demand Reduction Calculation

It is assumed that this measure operates within the Database of Energy Efficient Resources (DEER) peak period of 4 p.m. to 9 p.m. on weekdays at a constant load throughout the day.[2] The average and peak demand reduction calculations utilize the measured data of base case and measure case conveyor

[2] California Public Utilities Commission (CPUC). 2018. *Resolution E-4952.* October 11. OP 1.

toasters specified for electric savings. The average demand (baseline or measure case) is equal to the annual unit energy consumption (UEC) divided by the assumed annual hours of operation.

$$\boldsymbol{Demand_{avg}} = \frac{UEC\_year}{work\ hours\ per\ day\ x\ work\ days\ per\ year}$$

UEC_year =	*annual unit energy consumption (kWh/year)*
work hours per day =	*estimated working hours per day (hours)*
workdays per year =	*estimated working days per year (days/year)*

The average demand reduction is the difference between the baseline and measure case average demand. The estimated peak demand reduction is calculated as the average demand reduction multiplied by the coincident demand factor (CDF).

$$\boldsymbol{Peak\ Demand\ Reduction} = \left(Demand_{avg.base} - Demand_{avg.measure}\right) x\ CDF$$

$Demand_{avg}$ =	*average demand (kW)*
CDF =	*coincident demand factor*

The inputs for the calculation of peak demand reduction of a conveyor toaster are specified below.

Parameter	Value	Source
Coincident Demand Factor	0.90	Itron, Inc. 2005. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study - Final Report*. Prepared for Southern California Edison. Pages 3-15 to 3-17, Table 3-14.

GAS SAVINGS (THERMS)

Not Applicable, this is an electric measure only.

LIFE CYCLE

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration.

The methodology to calculate the RUL conforms with Version 6 of the Energy Efficiency Policy Manual, which recommends "one-third of the effective useful life in DEER as the remaining useful life until further study results are available to establish more accurate values."[3] This approach provides a reasonable RUL estimate without the requiring any a priori knowledge about the age of the equipment being

[3] California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 32.

replaced.[4] Further, as per Resolution E-4807, the California Public Utilities Commission (CPUC) revised add-on measures so that the EUL of the measure is equal to the lower of the RUL of the modified system or equipment or the EUL of the add-on component." [5]

The EUL specified for a commercial high performance conveyor toaster is specified below. There is no EUL ID specifically for electric toasters, but their method of operation is very similar to that of an electric convection oven, so the EUL ID: Cook‑ElecConvOven was assumed for this measure. Note that RUL is only applicable for add-on equipment and accelerated replacement measures and is not applicable for this measure.

Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs) -	12	California Public Utilities Commission (CPUC), Energy Division. 2003. *Energy Efficiency Policy Manual v 2.0.* Page 18 Table 4.1.
RUL (yrs)	n/a	n/a

BASE CASE MATERIAL COST ($/UNIT)

Base case material costs were calculated as the average of manufacturer list prices for all standard performance conveyor toaster models in the second quarter of 2020.[6] Cost data was collected directly from the manufacturer via pricing catalogs and/or direct price quotes. If a manufacturer list price was not available, then actual invoices documenting cost paid were used.

Because it is common knowledge that dealers do not pay the published list prices for equipment, it was necessary to apply a discount factor to the manufacturer list price data to more accurately reflect the actual prices paid for the equipment. A discount factor of 50% was based upon professional judgement by Food Service Technology Center (FSTC) staff. The baseline represents any existing standard performance conveyor toaster. Additional analysis to validate the reasonableness of this value was conducted by comparing AutoQuotes published prices with actual prices on invoices submitted through the Southern California Gas Company Instant Rebates! point-of-sale rebate program from 2015 through August of 2017. This verification revealed that a "list-to-actual" cost ratio for food service equipment of 50% is a reasonable average discount factor.

Technology	Average Cost	Sample Count
Standard performance conveyor toaster	$ 2,317.88	6

[4] KEMA, Inc. 2008. "Summary of EUL-RUL Analysis for the April 2008 Update to DEER." Memorandum submitted to Itron, Inc.

[5] California Public Utilities Commission (CPUC). 2016. Resolution E-4807. December 16. Page 13.

[6] Southern California Edison (SCE). 2020. "SWFS023-01 Conveyor Toaster, Commercial - Cost Research Breakdown.xlsx."

MEASURE CASE MATERIAL COST ($/UNIT)

Measure case material costs for high performance conveyor toaster were calculated as the average of manufacturer list prices for all high performance conveyor toaster models in the second quarter of 2020.[7] Cost data was collected directly from the manufacturer via pricing catalogs and/or direct price quotes. If a manufacturer list price was not available, then actual invoices documenting cost paid were used (see attached supporting cost files).

Because it is common knowledge that dealers do not pay the published list prices for equipment, it was necessary to apply a discount factor to the manufacturer list price data to more accurately reflect the actual prices paid for the equipment. A discount factor of 50% was based upon professional judgement by Food Service Technology Center (FSTC) staff. Additional analysis to validate the reasonableness of this value was conducted by comparing AutoQuotes published prices with actual prices on invoices submitted through the Southern California Gas Company Instant Rebates! point-of-sale rebate program from 2015 through August of 2017. This verification revealed that a "list-to-actual" cost ratio for food service equipment of 50% is a reasonable average discount factor.

Technology	Average Cost	Sample Count
High performance conveyor toasters	$ 3,021.67	3

BASE CASE LABOR COST ($/UNIT)

For all delivery types, a base case model does not require additional installation labor compared to a measure case high performance model. Base case and measure case model installation costs are expected to be the same for the customer and thus are not estimated for the incremental cost analysis.

MEASURE CASE LABOR COST ($/UNIT)

For all delivery types, a measure case high performance model does not require additional installation labor compared to a base case model. Base case and measure case model installation costs are expected to be the same for the customer and thus are not estimated for the incremental cost analysis.

NET-TO-GROSS (NTG)

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. The NTG value adopted for this measure is designated specifically for emerging technologies by the California Public Utilities Commission (CPUC).[8]

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[7] Southern California Edison (SCE). 2020. "SWFS023-01 Conveyor Toaster, Commercial - Cost Research Breakdown.xlsx."

[8] California Public Utilities Commission (CPUC). 2012. *Decision 12-05-015 in the Order Instituting Rulemaking to Examine the Commission's Post-2008 Energy Efficiency Policies, Programs, Evaluation, Measurement, and Verification, and Related Issues (R.09-11-014)*. Issued May 18. OP 14.

Net-to-Gross Ratios

Parameter	Value	Source
NTG – ET-Default	0.85	California Public Utilities Commission (CPUC). 2012. *Decision 12-05-015 in the Order Instituting Rulemaking to Examine the Commission's Post-2008 Energy Efficiency Policies, Programs, Evaluation, Measurement, and Verification, and Related Issues (R.09-11-014).* Issued May 18. OP 14.

GROSS SAVINGS INSTALLATION ADJUSTMENT (GSIA)

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. This GSIA rate is the current "default" rate specified for measures for which an alternative GSIA has not been estimated and approved.

Gross Savings Installation Adjustment

Parameter	GSIA	Source
Default- GSIA	1.00	California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31.

NON-ENERGY IMPACTS

Non-energy impacts for this measure have not been quantified.

DEER DIFFERENCES ANALYSIS

This section provides a summary of inputs and methods based upon the Database of Energy Efficient Resources (DEER), and the rationale for inputs and methods that are not DEER-based.

DEER Difference Summary

DEER Item	Comment
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	No
DEER Measure Case	No
DEER Building Types	No
DEER Operating Hours	No
DEER eQUEST Prototypes	No
DEER Version	DEER 2020, READI v2.5.1
Reason for Deviation from DEER	DEER does not contain High Performance Conveyor Toasters.
DEER Measure IDs Used	None
NTG	Source: DEER. The NTG of 0.85 is associated with NTG ID:*ET -Default*
GSIA	The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA*
EUL/RUL	Source: DEER. The value of 12 years is associated with EUL ID: *Cook-ElecConvOven*

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	12/07/2020	RMS Energy Consulting, LLC	First Draft.