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FOOD SERVICE

COMMERCIAL CONVECTION OVEN – GAS TO ELECTRIC FUEL SUBSTITUTION

SWFS022-01

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CONTENTS

MEASURE NAME

Commercial Convection Oven – Gas to Electric Fuel Substitution

STATEWIDE MEASURE ID

SWFS022-01

TECHNOLOGY SUMMARY

Commercial convection ovens are one of the most widely used appliances in the food service industry. Many food service operations rely heavily on the versatility of ovens; operators can cook varieties of foods in large quantities with a single appliance. This product diversity means that ovens are utilized in almost any type of food service operation.

Convection oven performance is determined by the American Society for Testing and Materials (ASTM) Standard Test Method for the Performance of Convection Ovens (F1496).[1] The ASTM Standard Test Method is the industry standard for quantifying the energy consumption, efficiency, and cooking performance of convection ovens based on testing in an approved and qualified laboratory.

MEASURE CASE DESCRIPTION

The measure case specification accounts for the idle energy rate, cooking energy efficiency rate, and production capacity of a convection oven. These represent the results of the convection oven study[2] conducted per the CPUC disposition[3] which includes testing data from the Food Service Technology Center & Food Service Testing Lab (SoCalGas), rebate participant survey, industry standard practice study, field data monitoring, and reviews of the California Energy Commission database and the Energy Star certified equipment.

Measure Case Specification for Commercial Convection Ovens

Oven Type		Idle Energy Rate	Cooking Energy Efficiency	Production Capacity (lb/hr)	Source
Electric	Half-Size	756 W	76%	49	The Southern California Gas Company (SCG). 2019. "Update Plan_Conv Oven_12292019.xlsx"
	Full-Size	1,353 W	76%	93	

[1]American Society for Testing and Materials (ASTM). 2013. ASTM F1496-13, Standard Test Method for the Performance of Convection Ovens. West Conshohocken (PA): ASTM International.

[2] The Southern California Gas Company (SCG). 2019. "Update Plan_Conv Oven_12292019.xlsx."

[3] Biermayer, P. (CPUC, Energy Division). 2019. "Non-standard Disposition for the convection oven workpaper SWFS001-01." Memorandum to Henry Liu (PG&E). January 4 [3] American Society for Testing and Materials (ASTM). 2013. *ASTM F1496-13, Standard Test Method for the Performance of Convection Ovens.* West Conshohocken (PA): ASTM International.

BASE CASE DESCRIPTION

The base case specification accounts for the idle energy rate, cooking energy efficiency rate, and production capacity of a convection oven. In the absence of mandatory state and federal regulations for commercial ovens, there is little incentive on the part of equipment manufacturers to test their baseline equipment. As such, the parameters for base case equipment were derived from results of a sample of low efficiency equipment tested by the Food Service Technology Center (FSTC) & Food Service Testing Lab (FSTL, SoCalGas). Cooking energy efficiency and production capacity are based upon the heavy-load potato test in American Society for Testing and Materials (ASTM) Standard Test Method for the Performance of Convection Ovens (F1496).[4]

Base Case Specifications for Commercial Convection Ovens

Oven Type		Idle Energy Rate	Cooking Energy Efficiency	Production Capacity (lb/hr)	Source
Gas	Half-Size	8,000 Btu/hr	42%	36	The Southern California Gas Company (SCG). 2019. "Update Plan_Conv Oven_12292019.xlsx"
	Full-Size	16,425 Btu/hr	41%	85	

CODE REQUIREMENTS

This measure is not governed by either state or federal codes and standards. The California 2014 Appliance Efficiency Regulations (Title 20)[5] requires that manufacturers report the convection oven idle energy rate per ASTM F1496 for the California Energy Commission (CEC) certified appliance database[6],but the standard does not specify the minimum performance requirement.

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

Convection oven performance is determined by applying the American Society for Testing and Materials (ASTM) Standard Test Method for the Performance of Convection Ovens (F1496).[7] The ASTM Standard Test Method is the industry standard for quantifying the energy consumption, efficiency, and cooking performance of convection ovens based on testing in an approved and qualified laboratory.

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[4] American Society for Testing and Materials (ASTM). 2013. ASTM F1496-13, Standard Test Method for the Performance of Convection Ovens. West Conshohocken (PA): ASTM International.

[5] California Energy Commission (CEC). 2014. 2014 Appliance Efficiency Regulations. CEC-400-2014-009-CMF.

[6] California Energy Commission (CEC). (n.d.) "Modernized Appliance Efficiency Database System (MAEDBS)." http://www.energy.ca.gov/appliances/.

[7] American Society for Testing and Materials (ASTM). 2013. ASTM F1496-13, Standard Test Method for the Performance of Convection Ovens. West Conshohocken (PA): ASTM International.

NORMALIZING UNIT

Each

PROGRAM REQUIREMENTS

Fuel Substitution Test

Per CPUC Decision 19-08-009 Rulemaking 13-11-005 "Decision Modifying the Energy Efficiency Three-Prong Test Related to Fuel Substitution", for all fuel substitution measures, the measure must 'not increase total source energy consumption when compared with the baseline comparison measure available utilizing the original fuel'[8]. Also, the measure 'must not adversely impact the environment compared to the baseline measure utilizing the original fuel. Fuel substitution calculations were conducted using CPUC's "Fuel Substitution Calculator" to confirm the measures in this workpaper pass Parts One and Two of the Fuel Substitution Test[9].

The measures in this workpaper are eligible because the pass the Fuel Substitution Test per the Fuel Substitution Technical Guidance for Energy Efficiency.

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 for Investor-Owned Utilities

Measure Application Type	Delivery Type	Sector
Normal replacement	DnDeemed	Ag
Normal replacement	DnDeemed	Ind
Normal replacement	DnDeemed	Com
Normal replacement	DnDeemDI	Ag
Normal replacement	DnDeemDI	Ind
Normal replacement	DnDeemDI	Com
Normal replacement	UpDeemed	Ag

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[8] California Public Utilities Commission (CPUC). 2019. "Decision 19-08-009 Rulemaking 13-11-005 Decision Modifying the Energy Efficiency Three-Prong Test Related to Fuel Substitution". August 1.

[9] Southern California Edison (SCE). 2019. "SWWH025-01 Fuel Substitution Calculator.xlsx".

Measure Application Type	Delivery Type	Sector
Normal replacement	UpDeemed	Ind
Normal replacement	UpDeemed	Com

Please note that new construction (NC) is not supported nor offered through Upstream delivery channel.

New construction measures are only eligible for downstream application under the following conditions. These are defined as new services in fuel substitution technical guidance[10].

- measures are installed in new areas of an existing building,
- measures are installed in a major renovation of an existing building, or
- measures are installed in capacity expansions of existing systems to serve existing and/or new load retrofits that require a new energy service.

For upstream/mid-stream delivery method, the participant baselines are unknown, and the spillover effects are unknown. The manufacturer or distributor doesn't know whether the purchased measure is replacing a gas or an electric baseline appliance. Claimed savings for these delivery types will be adjusted using the ratio of baseline gas appliance to total baseline appliances. These ratios will be determined from Commercial Food Service Technologies Participant Study[11]. The implementer shall survey 10% of the mid-stream and upstream installations, to determine actual gas/electric baseline proportions, and the program administrator shall adjust claimed savings based upon these survey results. This survey will be conducted annually, and sample survey question are as follows:

"What was the fuel source of the equipment you replaced?"

    a. Gas
    b. Electric
    c. I don't know/I'm not sure

In addition, for mid-stream delivery method, the implementer should provide the retailer or distribution location where the product was sold, rated capacity, and proposed building type where the product will be installed.

A survey will not be issued for upstream delivery method.

Required Documentation for Normal Replacement, New Construction, and Accelerated Replacement in Downstream and Direct Install Delivery

For downstream deemed and downstream direct-install delivery types, in addition to the standard information such as building type, climate zone, and capacity of the units, the following data must be submitted with each project application by the project developer:

- What is the existing fuel type for space heating?
- Did the site require any electric infrastructure upgrades for the proposed electrification measure? If yes, provide the itemized invoices with infrastructure upgrade costs.
- Did the owner install any other electrification measures at this site? If yes, list the measures and provide the itemized invoices with infrastructure upgrade costs (if any).

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[10] California Public Utilities Commission. 2019. "Fuel Substitution Technical Guidance for Energy Efficiency"

[11] SoCal Gas 2019, "Commercial Food Service Technologies Participant Study".

Eligible Products

All qualifying convection oven models must be approved and listed in the California Energy Commission (CEC) certified appliance database[12] or must meet the ENERGY STAR Version 2.2 eligibility criteria.

Energy Efficiency Requirements of Commercial Convection Ovens

Oven Type		Max. Idle Energy Rate	Min. Cooking Energy Efficiency	Source
Electric	Half-Size	1.0 kW	71%	ENERGY STAR. 2015. "Commercial Oven Key Product Criteria Version 2.2."
	Full-Size	1.6 kW	71%	

Eligible Building Types and Vintages

This measure is applicable for any nonresidential building type and any vintage.

Eligible Climate Zones

This measure is applicable for installation in any California climate zone.

Incentive Requirements

Deployment of the program may require rebates or financial incentives to participants that exceed the Incremental Measure Cost (IMC).[13] Incentives or rebates that exceed the incremental cost for a measure must be justified by individual PAs in addendum to workpaper submissions to document program implementation practice prior to program implementation.

PROGRAM EXCLUSIONS

As this is a fuel substitution measure, it is only eligible for replacement of existing gas equipment.

DATA COLLECTION REQUIREMENTS

Per CPUC Decision 19-08-009[14], building infrastructure costs which include panel upgrades or gas line installations/upgrades required to facilitate these fuel substitution measures shall be collected for all downstream and direct install measures. This revision incorporates the analysis of data collected from equipment tests, IOU rebates, CEC/ENERGY STAR database, surveys, and interviews with experts in the

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[12] California Energy Commission (CEC). (n.d.) "Modernized Appliance Efficiency Database System (MAEDBS)." http://www.energy.ca.gov/appliances/.

[13] Originally defined in D.92-09-080, the dual test was last modified in D.05-04-051

[14] California Public Utilities Commission (CPUC). 2019. "Decision 19-08-009 Rulemaking 13-11-005 Decision Modifying the Energy Efficiency Three-Prong Test Related to Fuel Substitution". August 1

industry. Additional updates to this workpaper could be made when more installation and equipment data become available.

USE CATEGORY

Food service (FoodServ)

ELECTRIC SAVINGS (kWh)

There are no electric savings because the fuel substitution measure includes replacing an existing gas convection oven with an electric convection oven. Therefore, electric usage at the facility will increase.

Annual Electric Unit Energy Consumption

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

$$UEC\_DAY = cooking\ energy + idle\ energy + preheat\ energy$$

Cooking energy is a function of the pounds of food cooked per day, the energy absorbed per pound of food product during cooking, and the measured heavy load cooking energy efficiency.

$$cooking\ energy = \left[\frac{LBFOOD \times EFOOD}{EFFICIENCY \times Btu/kWh}\right]$$

LBFOOD =	*Estimated pounds of food cooked per day (lb)*
EFOOD =	*ASTM energy to food ratio, the energy absorbed by food during cooking (Btu/lb)*
EFFICIENCY =	*Measured heavy load cooking efficiency (%, decimal format)*
Btu/kWh =	*Btu to kWh conversion factor*

Preheat energy is calculated as the product of the assumed number of preheats per day and the energy required per preheat mode.

$$preheat\ energy = (nP \ x \ EP)$$

nP =	*Estimated number of preheats per day (#)*
EP =	*Measured preheat energy (kWh)*

Idle energy is a function of the idle energy rate, operating hours per day, and production capacity; idle energy does not include preheat time.

$$idle\ energy = \left[IDLERATE \times \left(EHOUR - \frac{LBFOOD}{PC} - (nP \times TP/MinHr)\right)\right]$$

IDLE RATE =	*Measured idle energy rate (kW)*
EHOUR=	*Estimated operating hours per day (hrs)*
LBFOOD =	*Estimated pounds of food cooked per day (lbs)*
PC =	*Measured production capacity (lbs/hr)*
nP =	*Estimated number of preheats per day (#)*
TP =	*Estimated preheat time (min)*

$$MinHr = \quad \text{Constant, 60 minutes per hour (min)}$$

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

$$UEC\_YEAR = UEC\_DAY \times EDAYS$$

$UEC\_DAY =$ *Daily unit energy consumption (kWh)*

$EDAYS=$ *Estimated operating days per year (days)*

Annual Electric Unit Energy Savings

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

$$UES_{YEAR} = [UEC\_YEAR_{Base} - UEC\_YEAR_{Measure}]$$

UEC_YEAR_{Base} *=Annual UEC, baseline (kWh/year) = 0 kWh/year for fuel substitution measures*

$UEC\_YEAR_{Measure}$*=Annual UEC, measure (kWh/year)*

UES_YEAR *=Annual UES (kWh/year)*

Inputs and Assumptions

The inputs for the calculation of the UES of half-size and full-size electric convection ovens are specified below. The ASTM Energy to Food ratio is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato).

Electric UEC Inputs - Half-Size Convection Oven

Parameter	Measure Case Model	Source
Number of Preheats/Day	1	
Preheat Time (minutes)	7.7	
Preheat Energy (kWh)	0.70	
Idle Energy Rate (kW)	0.76	
Heavy Load Cooking Energy Efficiency (%)	76%	The Southern California Gas Company (SCG). 2019. "Update Plan_Conv Oven_12292019.xlsx"
Production Capacity (lb/hr)	49	
Pounds of Food Cooked/Day (lb)	122	
ASTM Energy to Food (Btu/lb)	250	
Operating Hours/Day (hours)	9.9	
Operating Days/Year (days)	270	

Electric Energy Use Inputs - Full-Size Convection Oven

Parameter	Measure Case Model	Source
Number of Preheats/Day	1	The Southern California Gas Company (SCG). 2019. "Update Plan_Conv Oven_12292019.xlsx"
Preheat Time (minutes)	8.5	
Preheat Energy (kWh)	1.39	
Idle Energy Rate (kW)	1.35	
Heavy Load Cooking Energy Efficiency (%)	76%	
Production Capacity (lb/hr)	93	
Pounds of Food Cooked/Day (lb)	122	
ASTM Energy to Food (Btu/lb)	250	
Operating Hours/Day (hours)	9.9	
Operating Days/Year (days)	270	

A sample calculation of daily and annual UEC of a measure case full-size electric convection oven is provided below.

$$Convection\ cooking\ energy = \left[\frac{122 \times 250 \times \frac{1}{3412.14}}{0.76}\right] = 11.75\ kWh$$

$$Convection\ idle\ energy = \left[1.35 \times \left(9.9 - \frac{122}{93} - (1 \times 8.5/60)\right)\right] = 11.39\ kWh$$

$$Preheat\ energy = (1 \times 1.39) = 1.39\ kWh$$

$$UEC_{Day} = 11.75 + 11.39 + 1.39 = 24.5\ kWh/day$$

$$UEC\_Year = 24.6\ kWh/day \times 270\ days/yr = 6,631\ kWh/yr$$

PEAK ELECTRIC DEMAND REDUCTION (KW)

In accordance with the requirements of the CPUC Fuel Substitution Technical Guidance, for Energy Efficiency, October 31, 2019, there will not be any peak demand reduction or penalty towards peak demand goal achievement from fuel substitution measures.[15]

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[15] California Public Utilities Commission. 2019. "Fuel Substitution Technical Guidance for Energy Efficiency".

GAS SAVINGS (THERMS)

The annual gas unit energy saving (UES) is calculated as the difference between the baseline and measure annual unit energy consumption (UEC). This is a fuel substitution measure therefore the baseline gas usage will be saved and will be replaced with electric consumption.

Annual Gas Unit Energy Consumption

As shown below, the daily UEC (baseline or measure case, all oven sizes) is equal to the sum of the energy required for cooking, preheat, and idle modes of operation.[16] These calculations and the inputs are provided below

$$UEC\_DAY = convection\ cooking\ energy +\ convection\ idle\ energy + preheat\ energy$$

Cooking energy is a function of the pounds of food cooked per day, the energy absorbed per pound of food product during cooking, and the measured heavy load cooking energy efficiency.

$$convection\ cooking\ energy = \left[\frac{LBFOOD \times EFOOD}{EFFICIENCY}\right]$$

$LBFOOD =$	*Estimated pounds of food cooked per day*
$EFOOD =$	*ASTM energy to food (Btu/lb) = Btu/pound of energy absorbed by food product during cooking based on ASTM F1496*
$EFFICIENCY =$	*Measured heavy load cooking energy efficiency %*

Preheat energy is calculated as the product of the assumed number of preheats per day and the energy required per preheat mode.

$$preheat\ energy =\ (nP\ x\ EP)$$

$nP =$	*Estimated number of preheats per day (#)*
$EP =$	*Measured preheat energy (Btu)*

Idle energy is a function of the idle energy rate, operating hours per day, and production capacity; idle energy does not include preheat time.

$$idle\ energy = \left[IDLERATE \times \left(EHOUR - \frac{LBFOOD}{PC} - (nP \times TP/60)\right)\right]$$

$IDLE\ RATE =$	*Measured idle energy rate (Btu)*
$EHOUR =$	*Estimated operating hours per day (hrs)*
$LBFOOD =$	*Estimated pounds of food cooked per day (lbs)*
$PC =$	*Measured production capacity (lbs/hr)*
$nP =$	*Estimated number of preheats per day (#/day)*
$TP =$	*Estimated preheat time (min)*

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[16] American Society for Testing and Materials (ASTM). 2013. *ASTM F1496-13, Standard Test Method for the Performance of Convection Ovens.* West Conshohocken (PA): ASTM International.

The **annual UEC** (baseline) is calculated as the daily UEC multiplied by the number of operating days per year.

$$UEC\_YEAR = \frac{UEC\_DAY \times EDAYS}{BtuTherm}$$

$UEC\_DAY =$ Calculated daily energy consumption (Btu/day)
$EDAYS=$ Estimated operating days per year (days)
$BtuTherm =$ Btu to therm conversion factor

Annual Gas Unit Energy Savings

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

$$UES_{YEAR} = [UEC\_YEAR_{Base} - UEC\_YEAR_{Measure}]$$

UEC_YEAR_{Base} =Annual UEC, baseline (therms/year)
$UEC\_YEAR_{Measure}$ =Annual UEC, measure (therms/year) = 0 therms/year for fuel substitution measures
UES_YEAR =Annual UES (therms/year)

Inputs and Assumptions

The inputs and assumptions for the UEC of half- and full-size commercial gas convection ovens are specified below. The ASTM energy to food ratio is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato).

Gas UEC Inputs - Half-Size Convection Oven

Parameter	Base Case Model	Source
Number of Preheats per Day	1	
Preheat Time (minutes)	12.4	
Preheat Energy (Btu)	6,000	
Idle Energy Rate (Btu/hr)	8,000	
Heavy Load Cooking Energy Efficiency (%)	42%	The Southern California Gas Company (SCG). 2019. "Update Plan_Conv Oven_12292019.xlsx"
Production Capacity (lb/hr)	36	
Pounds of Food Cooked per Day	122	
ASTM Energy to Food (Btu/lb)	250	
Operating Hours/Day	9.9	
Operating Days/Year	270	

Gas Energy Use Inputs - Full-Size Convection Oven

Parameter	Base Case Model	Source
Number of Preheats per Day	1	
Preheat Time (minutes)	11.7	
Preheat Energy (Btu)	13,096	
Idle Energy Rate (Btu/hr)	16,425	
Heavy Load Cooking Energy Efficiency (%)	41%	
Production Capacity (lb/hr)	85	The Southern California Gas Company (SCG). 2019. "Update Plan_Conv Oven_12292019.xlsx"
Pounds of Food Cooked per Day	122	
ASTM Energy to Food (Btu/lb)	250	
Operating Hours/Day	9.9	
Operating Days/Year	270	

A sample calculation of the daily and annual UEC of a base case half-size model is provided below.

$$UEC_{Day} = 74,101.9 + 135,213.5 + 13,095.7 = 222,411 \; Btu \;/day$$

$$convection \; cooking \; energy = \left[\frac{122 \times 250}{0.41}\right] = 74,101.9 \; Btu$$

$$convection \; idle \; energy = \left[16,425 \times \left(9.9 - \frac{122}{85} - (1 \times 11.7/60)\right)\right] = 135,213.5 \; Btu$$

$$preheat \; energy = (1 \times 13,096) = 13,095.7 \; Btu$$

$$Annual \; Energy \; Consumption = \frac{222,411 \; Btu}{1 \; day} \times 270 \; days \times \frac{1 \; therm}{100,000 \; Btu}$$

$$UEC_{Year} = 601 \; therms/year$$

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. EUL is often, but not always, derived from measure persistence or retention studies. 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 EUL specified for the commercial convection oven is presented below. Note that RUL is only applicable for add-on equipment and accelerated measures and is not applicable for this measure.

Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs)	12	Robert Mowris & Associates. 2005. *Ninth Year Retention Study of the 1995 Southern California Gas Company Commercial New Construction Program*. Prepared for Southern California Gas Company. Study ID Number 718A. 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)

The base case material cost for equipment *delivered via direct install* is equal to $0.

For *all other delivery types*, the base case material cost was derived as the average of the manufacturer published list prices for gas convection ovens retrieved from the AutoQuotes online catalog for foodservice equipment and supplies.[17] Because it is common knowledge that dealers do not pay the published list prices for equipment, it was necessary apply a discount factor to the AutoQuotes data to more accurately reflect the actual prices paid for the equipment. The 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 compared 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.[18] This verification revealed that a "list-to-actual" cost ratio for food service equipment of 50% is a reasonable average discount factor.

MEASURE CASE MATERIAL COST ($/UNIT)

The measure case material costs for *all delivery types* were derived as the average of the manufacturer list prices for energy efficient electric convection ovens retrieved from the AutoQuotes online catalog for foodservice equipment and supplies.[19] Because it is common knowledge that dealers do not pay the published list prices for equipment, it was necessary apply a discount factor to the AutoQuotes data to more accurately reflect the actual prices paid for the equipment. The discount factor of 50% was based upon professional judgement by 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.[20] This verification revealed that a "list-to-actual" cost ratio for food service equipment of 50% is a reasonable average discount factor.

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[17] Food Service Technology Center (FSTC). 2016. "Ovens 2016 Price Updates.xlsx."

[18] Energy Solutions. 2017. "2016 IMC Analysis - For Cal TF (Energy Solutions).xls."

[19] Food Service Technology Center (FSTC). 2016. "Ovens 2016 Price Updates.xlsx."

[20] Energy Solutions. 2017. "2016 IMC Analysis - For Cal TF (Energy Solutions).xls."

BASE CASE LABOR COST ($/UNIT)

The base case labor cost for equipment *delivered via direct install* is equal to $0.

For *all other delivery types*, a high efficiency model does not require additional installation labor compared to a base case model unless infrastructure cost are needed due to fuel substitution. Since this measure is applicable for normal replacement installations, the base case and measure case model installation costs are expected to be the same for the customer and thus were not estimated for the incremental cost analysis.

MEASURE CASE LABOR COST ($/UNIT)

The measure case labor cost for equipment *delivered via direct install* will be derived as the average installation cost submitted by one or more implementation contractors. The actual installation cost can vary by contractor, the date when the work occurred, and by the volume of each specific contractor's business. Contractor costs are confidential information and are based upon contractually agreed upon pricing as established in their purchase order with the program administrator. Therefore, the program administrator program tracking systems are the only source for the labor installation cost data. The program administrator will utilize the actual program cost to evaluate the cost-effectiveness of the measure.

For *all other delivery types*, a high efficiency model does not require additional installation labor compared to a base case model unless infrastructure cost are needed due to fuel substitution. Since this measure is applicable for normal replacement installations, the base case and measure case model installation costs are expected to be the same for the customer and thus not estimated for the incremental cost analysis.

Additional infrastructure cost may occur because a commercial kitchen will likely have necessary breakers and plugs to operate 240v equipment but may require additional electrical wiring and outlets. The estimated cost for additional wiring, conduit, outlets and installation labor is $400. This infrastructure cost is estimated for informational purposes only and is not included as part of the labor or measure cost. Infrastructure cost will be gathered as part of program implementation.

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. Based on the CPUC's Fuel Substitution Technical Guidance for Energy Efficiency[21] document, the value below should be used for fuel substitution measures until further data is available.

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[21] California Public Utilities Commission. 2019. "Fuel Substitution Technical Guidance for Energy Efficiency".

Net-to-Gross Ratios

Parameter	Value	Source
NTG – FuelSubst-Default	1.0	California Public Utilities Commission. 2019. Decision 19-06-008. And California Public Utilities Commission. 2019. Fuel Substitution Technical Guidance for Energy Efficiency.

GROSS SAVINGS INSTALLATION ADJUSTMENT (GSIA)

The gross savings installation adjustment (GSIA) 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 Rate

Parameter	Value	Source
GSIA	1.0	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

The table below summarizes the inputs and methods that are and are not based upon the Database for Energy Efficient Resources (DEER).

DEER Difference Summary

DEER Item	Comment / Used for Workpaper
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	n/a
DEER Measure Case	n/a
DEER Building Types	Yes
DEER Operating Hours	n/a
DEER eQUEST Prototypes	n/a
DEER Version	n/a
Reason for Deviation from DEER	DEER does not contain information on energy use or savings for an energy-efficient electric or gas commercial convection oven measure.
DEER Measure IDs Used	n/a
NTG	Source: DEER. The NTG of 1.0 is associated with NTG ID: FuelSubst-Default
GSIA	Source: DEER 2016. The value of 1.0 is associated with GSIA ID: *Def-GSIA*
EUL/RUL	Source: DEER 2016. The EUL of 12 years is associated with EUL ID: *Cook-ElecConv* and *Cook- GasConvOven*

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary
01	6/29/2020	Keith Valenzuela, AESC Inc.	Gas to Electric Fuel Substitution based on SWFS001-02 Commercial Convection Oven