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APPLIANCE

SWAP013-01 RESIDENTIAL COOKING APPLIANCES – FUEL SUBSTITUTION

CONTENTS

MEASURE NAME

Residential Cooking Appliances – Fuel Substitution

STATEWIDE MEASURE ID

SWAP013-01

EFFECTIVE DATE

December 13, 2019

TECHNOLOGY SUMMARY

Residential cooking appliances include ovens, cooktop, and full ranges. Range technology consists of an oven with a built-in cooktop.[1] Ovens can be categorized as either self-cleaning or manual-clean and be either free-standing or wall configurations. Self-cleaning ovens heat to temperatures around 880°F for up to three hours to decompose food soils. This resultant ash can then be wiped out with a wet cloth. Without this technology, the oven must be cleaned by scrubbing the soilage with soap and water.[2]

An **Induction Range** is an electric oven with a built-in **Induction cooktop**. Induction technology works on the principle of magnetic induction, where excited eddy currents in ferromagnetic cookware within the presence of an oscillating magnetic field dissipate heat through the Joule effect. This heat is directly generated by the cookware and is transmitted to the food within it, lessening thermal conduction heat loss between the heating element and the cookware.[3] Induction cookers are composed of a switching power electronics circuit that delivers high-frequency current to a planar coil of wire embedded in the cooking surface. The cookware is magnetically coupled to the coil by the oscillating magnetic field. Current flows in the cooking vessel due to the low resistance of the metal. Resistance is a function of permeability and resistivity of the cookware as well as the frequency of excitation.[4] Typical induction cookers operate at switching frequency between 25 kHz and 50 kHz, which restricts coupling to ferromagnetic cookware such as cast iron and some alloys of stainless steel.[5] According to manufacturers,

[1] Bell, Todd, Charles Bohlig, David Cowen, Victor Kong, Judy Nickel, Greg Sorensen, Richard Young, Fred Wong, and David Zabrowski, Commercial Cooking Appliance Technology Assessment. 2002. Fisher Nickel Inc. Food Service Technology Center.

[2] General Electric (GE). 2019. https://www.geappliances.com/ge/range-stove/range-cleaning-options.htm

[3] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[4] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[5] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

induction stoves heat food faster, are easier to clean, are less likely to burn those using them, and have a higher cooking efficiency than both electrical resistance and gas ranges.[6]

Historically, gas ranges have held several advantages over electrical ranges such as a faster heating time, faster response time to control adjustments, higher durability, and lower operating cost. Key disadvantages of gas ranges are that they operate at a much lower cooking efficiency and are unregulated greenhouse gas emitters.[7] Additionally, gas ovens utilize significant electric energy during ignition.[8]

Cooking Efficiency is calculated as the ratio of thermal energy absorbed by the food divided by the energy consumed by the device as it is heating the food.[9] At higher cooking efficiencies and with faster heat-up times, induction cooktops have the best heat-up performance and higher heat input compared to electric resistance and gas cooktop.[10] Although induction ranges have a higher initial equipment cost than both electrical resistance and gas ranges and a higher operating cost than gas ranges, the benefits of increased efficiency and a lower pollutant output both for Greenhouse Gases (GHGs) and for human health make them desirable replacement options.

[6] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[7] Bell, Todd, Charles Bohlig, David Cowen, Victor Kong, Judy Nickel, Greg Sorensen, Richard Young, Fred Wong, and David Zabrowski, Commercial Cooking Appliance Technology Assessment. 2002. Fisher Nickel Inc. Food Service Technology Center.

[8] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[9] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[10] Livchak, Denis, Russel Hedrick, Richard Young, Mark Finck, Todd Bell, and Michael Karsz. Residential Cooktop Performance and Energy Comparison Study. 2019. Frontier Energy Report #501318071-R0.

MEASURE CASE DESCRIPTION

The measure case is defined as either the installation of high efficiency electric ranges with induction cooktop, standalone induction cooktops, fully electric resistance cooking ranges, and electric resistance wall ovens replacing existing natural gas equipment.

Statewide Offering ID	Measure
A	Induction Cooktop replacing Gas Cooktop
B	Electric Range with Induction Cooktop replacing Gas Range
C	Electric Range with Electric Resistance Cooktop replacing Gas Range
D	Electric Resistance Wall Oven replacing Gas Wall Oven

Measure Case Technology Characterization

Measure characterization for this measure is being informed by CASE Plug Load and Lighting Modeling (Measure Number: 2016-RES-ACM-D)[11] and US Energy Efficiency and Renewable Energy Office[12].

Equipment	Cooking Efficiency ($BTU_{FOOD}/BTU_{APPLIANCE}$)
Electric Induction Cooktop	84%[13]
Electric Resistance Cooktop	74%[14]
Electric Resistance Oven - Standard	10.8%[15]
Electric Resistance Oven – Self Cleaning	9.8%[16]

[11] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[12] Energy Efficiency and Renewable Energy Office (EERE). 2007. ID EERE-2006-STD-0127-012. November 15. https://www.regulations.gov/document?D=EERE-2006-STD-0127-0122

[13] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[14] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[15] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling, page 65. June 2016. California Utilities Statewide Codes and Standards Team.

[16] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling, page 65. June 2016. California Utilities Statewide Codes and Standards Team.

BASE CASE DESCRIPTION

The base case is defined as a natural gas range, a natural gas wall oven, or a natural gas standalone cooktop.

Baseline characterization for this measure is being informed by CASE Plug Load and Lighting Modeling (Measure Number: 2016-RES-ACM-D).[17] The measure draws from a variety of existing data sources that are used to inform assumptions about the range baselines discussed in the scope of this paper. Based on the estimated age of devices in new homes, energy efficiency standards, and market trends, the statewide CASE Team determined the likely efficiency of ranges to be used in homes built during the 2016 code cycle.

Base Case Technology Characterization

Equipment	Cooking Efficiency
Gas Cooktop	39.9%[18]
Gas Oven - Standard	4.4%[19]
Gas Oven – Self Cleaning	5.7%[20]

CODE REQUIREMENTS

Test methods for the measurement of cooking efficiency include standardized DOE procedures for electric and gas cooktop, modified, standardized DOE procedures to test induction cooktop, ASTM 2012 standard F1521, and ANSI standard Z83.11. Each takes a different methodology to obtain cooking efficiency and can be used as verification for each other.[21]

Residential cooking appliances do not fall under California Building Energy Efficiency Standards (Title 24).

This measure is not governed by the California Appliance Efficiency Standards (Title 20) or federal regulations.

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[17] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[18] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[19] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[20] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[21] Livchak, Denis, Russel Hedrick, Richard Young, Mark Finck, Todd Bell, and Michael Karsz. Residential Cooktop Performance and Energy Comparison Study. 2019. Frontier Energy Report #501318071-R0.

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20	N/A	N/A
CA Building Energy Efficiency Standards – Title 24 (2019)	N/A	N/A
Federal Standards	N/A	N/A

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"[22], 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'. 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.

Measure Implementation Eligibility

All measure application type, delivery type, and sector combinations 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.

[22] 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

Implementation Eligibility

Measure Application Type	Delivery Type	Sector
NR	DnDeemed	Res
NR	DnDeemDI	Res
NR	UpDeemed	Res
NC	DnDeemed	Res
NC	DnDeemDI	Res

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 (Residential Appliance Saturation Survey (RASS)[23]. 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."

Eligible Products

General Eligibility Requirements

Installed equipment must be a fully electric cooking range, electric oven with induction cooktop, electric wall oven, or a standalone induction cooktop. Existing base equipment must be disposed.

Eligible Building Types and Vintages

This measure is applicable for all residential building types (single family, multifamily, and mobile homes) of existing vintage.

Eligible Climate Zones

This measure is applicable in all California climate zones.

[23] California Energy Commission. 2010. "2009 California Residential Appliance Saturation Study".

Incentive Amounts

Fuel substitution measures face market barriers, including consumer market failures and supplier market failures.[24] Deployment of the program may require rebates or financial incentives to participants that exceed the measure cost. The program may pass the TRC test, but fail the PAC test. Incentives or rebates that exceed the TRC cost for a measure may be requested in workpaper submissions, to be approved by Commission Staff.[25]

PROGRAM EXCLUSIONS

As this is a fuel substitution measure, it is eligible for replacement of existing gas equipment. New construction measures are only eligible for downstream application, when:

- 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.

These exceptions will follow the same baseline technology requirements as a Normal Replacement measure application type.

If the replacement equipment is a range or induction cooktop, the cooktop must have either 4 or 5 burners.

DATA COLLECTION REQUIREMENTS

Baseline equipment type and fuel source must be verified, for downstream measures.

Per CPUC Decision 19-08-009[26], 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 measures.

USE CATEGORY

AppPlug

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[24] Energy+Environmental Economics. April 2019. "Residential Building Electrification in California

https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf

Consumer economics, greenhouse gases and grid impacts".

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

[26] 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

ELECTRIC SAVINGS (kWh)

Data Sources

The following sources were used to determine the baseline and measure energy usage, and savings all technologies. CASE 'Plug Loads and Lighting Modeling' contains a technical assessment of induction cooking performed by the Electric Power Research Institute (EPRI) for the California Energy Commission (CEC). Frontier Energy 'Residential Cooktop Performance and Energy Comparison Study' has substantive cooking efficiency test results for induction, natural gas, and electric resistance cooktops. EPRI 'Induction Cooking Technology Design and Assessment' contains a comprehensive description and energy performance assessment of commercial cooking equipment. Energy Efficiency and Renewable Energy Office (EERE) 'Draft Cooktop Life-Cycle Cost Spreadsheet' is a database of cooktop costs and life-cycles.

Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling[27]

a. Oven and cooktop energy use disaggregation and per-cycle energy use
b. Estimated Annual Energy Consumption (AEC) of gas and electric ranges, cooktops and ovens
c. Fully electric resistance and gas cooktop cooking efficiencies
d. Electric resistance and natural gas oven efficiencies

Frontier Energy: Residential Cooktop Performance and Energy Comparison Study[28]

a. Induction cooktop cooking efficiency
b. Fully electric and gas cooktop cooking efficiencies

Electric Power Research Institute (EPRI): Induction Cooking Technology Design and Assessment[29]

c. Fully electric and gas range cooking efficiencies

Energy Efficiency and Renewable Energy Office (EERE): Draft Stovetop Life-Cycle Cost Spreadsheet[30]

a. Induction cooktop cooking efficiency

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[27] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[28] Livchak, Denis, Russel Hedrick, Richard Young, Mark Finck, Todd Bell, and Michael Karsz. Residential Cooktop Performance and Energy Comparison Study. 2019. Frontier Energy Report #501318071-R0.

[29] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[30] Energy Efficiency and Renewable Energy Office (EERE). 2007. ID EERE-2006-STD-0127-002. November 15. https://www.regulations.gov/document?D=EERE-2006-STD-0127-0122

Cooktop Consumption

Using the estimated cooking efficiency of 84% the total consumption of an induction stove was calculated using the cooking efficiency and consumption of an electric resistance stove as shown below.[31]

$$(Consumption)_{Induction}\ [kWh] = (\frac{\eta_{Electrical\ Resistance}}{\eta_{Induction}}) \times (Consumption)_{Electrical\ Resistance}\ [kWh]$$

$$\Longrightarrow (Consumption)_{Induction}\ [kWh] = \left(\frac{.74}{.84}\right) \times (102\ [kWh]) = 89.86\ [kWh]$$

Technology	Fuel Source	Efficiency (Cooking)	Therms	kWh
Gas Cooktop	Natural Gas	40%[32]	5.74[33]	0.00
Electric Resistance Cooktop	Electricity	74%[34]	0.00	102.00[35]
Induction Cooktop	Electricity	84%[36]	0.00	89.86[37]

Oven Consumption

Total consumption for four technologies was compiled from the CASE report.[38] Since the CASE report calculated the energy usage for the oven and cooktop separately and since the ovens were further separated by standard and self-cleaning units, a blended energy usage for ovens was developed by applying the market share of standard and self-cleaning gas and electric ovens. The table below shows the weighted energy consumption for each oven type based on the CASE report. [39] It should be noted that gas ovens also use electric energy for ignition purposes.

[31] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[32] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[33] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[34] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[35] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[36] Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

[37] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[38] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

[39] Rubin, Eric, Daniel Young, Maxmilian Hietpas, Arshak Zakarian, and Phi Nguyen. Codes and Standards Enhancement Initiative (CASE): Plug Loads and Lighting Modeling. June 2016. California Utilities Statewide Codes and Standards Team.

Residential Oven Characteristics	Electric Resistance		Natural Gas	
	Standard	Self-Cleaning	Standard	Self-Cleaning
Cooking Energy	118 kWh	130 kWh	8.77 therms	6.77 therms
Self-Clean Energy	N/A	32.8 kWh	N/A	0.7 kWh 1.7 therms
Standby Energy	19.2 kWh	19.2 kWh	N/A	19.2 kWh
Ignition Energy	N/A	N/A	43.5 kWh	43.5 kWh
Total Energy	137.2 kWh	182 kWh	43.5 kWh 8.77 therms	63.4 kWh 8.47 therms
Relative Market Share per Fuel Type	*23.2%*	*76.8%*	*45.9%*	*54.1%*
Weighted Total Energy	**171.61 kWh**		**54.27 kWh 8.61 therms**	

Total Consumption and Savings

Saving impacts for calculated from each gas baseline to electric measure are found below. These exclude HVAC IE or savings due to reduced kitchen hood consumption.

Measure	Baseline Consumption		Measure Consumption		Measure Savings	
	Therms	kWh	Therms	kWh	Therms	kWh
Induction Cooktop replacing Gas Cooktop	5.74	0	0	89.9	5.74	-89.9
Electric Range with Induction Cooktop replacing Gas Range	14.35	54.27	0	261.5	14.35	-207.20
Electric Range with Electric Resistance Cooktop replacing Gas Range	14.35	54.27	0	273.6	14.35	-219.3
Electric Resistance Wall Oven replacing Gas Wall Oven	8.61	54.27	0	171.6	8.61	-117.3

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.[40]

[40] 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.

GAS SAVINGS (THERMS)

Refer to the 'Electric Savings (kWh)' section for the therms savings methodology.

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 EUL and RUL are specified below.[41]

Effective Useful Life and Remaining Useful Life

Parameter	EUL ID	Value	Source
EUL (yrs)	Appl-Elec_Cooking	16	Per 2016-09-02 Energy Conservation Program: Energy Conservation Standards for Residential Conventional Cooking Products; Supplemental notice of proposed rulemaking (SNOPR)[42]
RUL (yrs)		N/A	N/A

BASE CASE MATERIAL COST ($/UNIT)

The base case cost was obtained through online prices research from various retailer websites in the third quarter of 2019. Costing was normalized between equipment types due to large price jumps due to specific add-ons (ie. two-oven ranges, Smart system [a system that includes automated controls and wi-fi connectivity], etc.). Base material costs per range type were restricted to single-oven, five to six cubic ft. oven volume, non-Smart, four or five burner ranges. Costing for standalone cooktops were restricted to four or five burners and at least 1500 cubic in. volume. Normalization was applied to more precisely compare samples. Normalization was not necessary for wall ovens since their sizes do not vary greatly and SMART wall ovens do not look to greatly impact cost. It should be noted that based on pricing exercises conducted over the span of multiple weeks, retail prices for the same retailer and product can vary up to 12%.

[41] California Public Utilities Commission (CPUC), Energy Division. 2019. *DEER resolution E-5009.* 12 September 2019.

[42] Energy Conservation Program: Energy Conservation Standards for Residential Conventional Cooking Products.

Standardized Baseline Cost

Appliance	Standardized Average Appliance Cost[43]	Sample Count
Natural Gas Cooktop	$ 1,191.79	63
Natural Gas Oven with Natural Gas Cooktop	$ 833.99	44
Natural Gas Wall Oven	$ 1,304.56	12

The total equipment cost includes 8.75% tax.

MEASURE CASE MATERIAL COST ($/UNIT)

The measure case cost was obtained through online prices research from various retailer websites in the third quarter of 2019. Costing was normalized between equipment types due to large price jumps due to specific add-ons (ie. two-oven ranges, Smart system [a system that includes automated controls and wi-fi connectivity], etc.). Electric ranges with induction cooktops were normalized according to single-oven, five to six cubic ft. oven volume, non-SMART ranges. A similar approach was utilized for electric resistance where they were restricted to five to six cubic ft. oven volume and non-SMART criteria. Induction standalone cooktops were normalized to four or five burners and at least 1,500 cubic in. volume. Normalization was not necessary for wall ovens since their sizes do not vary greatly and SMART wall ovens do not have a high correlation with cost. Until more updated studies are done, the online retail point of sales pricing is the best available data to support the measure equipment cost. It should be noted that based on pricing exercises conducted over the span of three weeks, retail prices for the same retailer and product can vary up to 12%.

Standardized Measure Cost

Technology	Standardized Average Range Cost[44]	Sample Count
Induction Cooktop	$ 1,635.56	114
Electric Oven with Induction Cooktop	$ 1,657.23	24
Electric Range with Electric Cooktop	$ 708.00	23
Electric Resistance Wall Oven	$ 1,541.04	21

The total equipment cost includes 8.75% tax.

[43] Southern California Edison (SCE). 2019. SWAP013-01 Cooking Appliance Costs.xlsx”.

[44] Southern California Edison (SCE). 2019. SWAP013-01 Cooking Appliance Costs.xlsx”.

Cost Methodology/Approach

The incremental measure cost is the cost differential of the efficient option over the standard option attributable to features related to energy efficiency performance. A robust analysis would involve developing a taxonomy of features and determining the cost of each feature or component. This is generally done through such methods as product teardowns or hedonic price modeling. However, for the applicable technologies, these methods become unwieldy because it is difficult to develop a standardized set of features due to various possible implementations of the technology and we may not find a reliable correlation between features and price. Hence, the standardization of baseline and measure parameters.

Incremental Measure Cost

Baseline	Measure	Incremental Measure Cost
Natural Gas Cooktop	Induction Cooktop	$ 443.77
Natural Gas Oven with Natural Gas Cooktop	Electric Oven with Induction Cooktop	$ 823.24
Natural Gas Oven with Natural Gas Cooktop	Electric Range with Electric Cooktop	-$ 125.99
Natural Gas Wall Oven	Electric Resistance Wall Oven	$ 236.48

Infrastructure Costs

For a natural gas cooking equipment to electric cooking equipment conversion infrastructure upgrades would include a capping off the natural gas line and the addition of a 208/240 power outlet. These infrastructure costs were estimated using RSMeans Online data[45] and online retailer costs. RSMeans hourly labor rates for a residential electrician[46] were used to estimate labor costs. See the table below for details and the cost calculations for more details.[47]

Description of Work	Labor Hours	Labor Cost	Material Cost	Total Cost
Cap Existing Gas Line w/ Brass Plug for Natural Gas lines.	0.250	$16.89	$4.00	$20.89
Range Outlet, 50 amp, 240 volt receptacle, 30' of wiring	2.00	$135.10	$127.00	$262.10
Total cost	**2.25**	**$151.99**	**$131.00**	**$282.99**

[45] 2019 RSMeans Electrical Cost Data

[46] RSMeans Residential Labor Rates, https://www.rsmeansonline.com/References/LABORRATE/2-Year%202019%20Labor%20Rates/Residential%20Labor%20Rates.PDF , "Residential Labor Rates.pdf"

[47] Southern California Edison (SCE). 2019. "SWAP013-01 Cooking Appliance Costs 11-5-2019.xlsx"

BASE CASE LABOR COST ($/UNIT)

Labor cost was found from RS Means Online database (2019)[48]. All equipment costing included a range of labor hours, thus the average labor hours per equipment was selected.

Description[49]	Min Labor Hours	Max Labor Hours	Average Labor Hours	Residential Electrician Hourly Rate with O&P[50]	Total Labor Cost
Cooking Range, Free Standing	1.6	4	2.8	$ 67.55	$189.14
Countertop Cooktop	1.333	2.667	2	$ 67.55	$135.10
Wall Oven	2	4	3	$ 67.55	$202.65

MEASURE CASE LABOR COST ($/UNIT)

The labor costs for both the measure and base case are assumed to be the same. Labor costs for both cases are based on RS Means Online database (2019).[51]

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 values for fuel substitution measures are based upon direction in the CPUC's 2019 Decision 19-08-009 [52] and Fuel Substitution Technical Guidance for Energy Efficiency documents.[53]

Adjusting the baselines in fuel substitution measure is a more complex approach since there are two fuel sources that will be mixed together and in addition to it the NTG may need to be modified (default for electric to electric and 1 for Gas to electric) to adjust for the net claimable savings.

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[48] 2019 RSMeans Electrical Cost Data

[49] 2019 RSMeans Electrical Cost Data

[50] RSMeans Residential Labor Rates, https://www.rsmeansonline.com/References/LABORRATE/2-Year%202019%20Labor%20Rates/Residential%20Labor%20Rates.PDF , "Residential Labor Rates.pdf"

[51] 2019 RSMeans Electrical Cost Data

[52] 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

[53] 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.

Net-to-Gross Ratios

Parameter	Value	Source
NTG – FuelSubst-Default	1.0	California Public Utilities Commission. 2019. Decision 19-08-009 . And California Public Utilities Commission. 2019. Fuel Substitution Technical Guidance for Energy Efficiency.

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.

Gross Savings Installation Adjustment Rates

Parameter	GSIA	Source
GSIA	1.0	California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31.

DEER DIFFERENCES ANALYSIS

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based.

DEER Difference Summary

DEER Item	Comment / Used for Workpaper
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	No
DEER Measure Case	No
DEER Building Types	Yes
DEER Operating Hours	No
DEER eQUEST Prototypes	No
DEER Version	N/A
Reason for Deviation from DEER	The DEER 2019/2020 database does not include induction stove measures.
DEER Measure IDs Used	N/A
NTG	Source: DEER. The NTG of 1.0 is associated with NTG ID: FuelSubst-Default
GSIA	Source: DEER. The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA*
EUL/RUL	Source: DEER per 2016-09-02 Energy Conservation Program: Energy Conservation Standards for Residential Conventional Cooking Products. The value of 16 years with EUL ID: Appl-Elec_Cooking

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision Effective Date and Approved By
01	11/18/2019	Brandon Yamasaki, TRC	First draft of workpaper.
02	01/22/2020	Brandon Yamasaki, TRC	EUL Update Per DEER2020:D20 v1.0
	05/20/2020	Jesse Manao, SCE	- Added SDGE Implementation to EAD Tables - Corrected Measure Impact Type