Commercial Cooktop Fuel Substitution

Final Report

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Executive Summary

The Commercial Cooktop Fuel Substitution project is developing a new measure package for the electronic Technical Reference Manual (CA eTRM). The measure is designed to show the benefits of utilizing electric induction cooktops in place of natural gas-fired cooktops in a commercial environment. The project team used the existing measure package for commercial electric and gas cooktops, SWFS026, to develop the new measure. Commercial Cooktop Fuel Substitution will support California's decarbonization goals by introducing a new fuel-substitution measure for the commercial foodservice industry. Natural gas is the most used fuel in commercial cooking and cooktops are one of the most used commercial kitchen appliances. Electric induction cooktops are gaining acceptance, and the introduction of a new fuel-substitution measure will help increase market share of the appliances and promote electrification of the food service industry by enabling deemed savings and incentives for commercial cooktop fuel substitution.

The proposed project supports California Public Utilities Commission (CPUC) Decision 23-04-035 by developing a fuel-substitution measure package for customers switching from natural gas to electric. The project aims to deliver a comprehensive measure package, fully developed and ready for approval by the CPUC. This package will be submitted to the California Technical Forum (Cal TF) measure screening committee and will encompass the creation of a draft measure packet within the CA eTRM, along with all necessary review and editing tasks for Cal TF affirmation.

Abbreviations and Acronyms

Acronym	Meaning
CA eTRM	California Electronic Technical Reference Manual
Cal TF	California Technical Forum
CEW	California Energy Wise
CFS	Commercial foodservice
CPUC	California Public Utilities Commission
IMC	Incremental measure cost
IOU	Investor-owned utility
MMBtu	Million British thermal unit
MP	Measure package
POS	Point of sale
QPL	Qualified products list
SCE	Southern California Edison

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Introduction

We developed a new cooktop fuel-substitution measure offering for the CA eTRM to address an opportunity to supplement an existing cooktop measure with the option of switching fuel from natural gas to electric. The Instant Rebates Point of Sale (POS) Foodservice Program provides incentives on gas and electric cooktops via the existing cooktop measure, SWFS026, but cannot incentivize fuel-switching efforts without a deemed fuel-substitution measure package (MP). To encourage the adoption of electric cooking and meet California's decarbonization goals, customer incentives are required to bring costs to parity and promote the replacement of gas equipment with electric alternatives. This project developed a fuel-substitution measure that will allow the Instant Rebates program and investor owned utility (IOU) downstream programs to implement and promote a new fuel-substitution measure in addition to the existing commercial food service (CFS) fuel-substitution measures.

Background

Gas cooktops are a ubiquitous workhorse of many commercial kitchens and make up as much as 95 percent of cooktops used in CFS kitchens. Induction cooking, in comparison, is a growing market that provides more potential for fuel substitution efforts than other CFS measures because of the energy savings and non-energy benefits it provides, such as reduced ambient heat, ease of cleaning, high-production cooking, and the relative ease and low cost of converting. However, induction cooktops are still a relatively new product in commercial kitchens, comprise a small market share, and face hurdles to industry acceptance due to historical use, low cost of natural gas cooktops and lack of experience by end-users. Additionally, operators can potentially incur significant electrical upgrade costs when adding electric equipment and circuits.

Objectives

The Commercial Cooktop Fuel Substitution Project is developing a new measure in the California electronic Technical Reference Manual (CA eTRM) for use in the California Instant Rebates midstream foodservice program and applicable IOU downstream programs. We used the existing MP for commercial electric and gas cooktops, SWFS026, to develop this new MP. The proposed project supports California Public Utilities Commission (CPUC) Decision 23-04-035 by developing a fuel-substitution MP for customers switching from natural gas to electric. The project aimed to deliver a comprehensive MP, fully developed and ready for approval by the CPUC. This package has been submitted to the California Technical Forum (Cal TF) measure screening committee and encompasses the creation of a draft measure packet within the CA eTRM, along with all necessary review and editing tasks for Cal TF affirmation.

Methodology & Approach

Measure Package Development

The methodology used for this project follows the requirements of the MP review process for California, including the utilization of the CA eTRM measure log for receiving and providing feedback. The project is following the Cal TF process for submitting and approving MPs. The Cal TF website provides details of each step of the process: http://www.caltf.org/submit-a-measure. An overview of the process is listed below by step:

1. Submit measure proposal form – Energy Solutions
2. Measure proposal approval – Cal TF
3. Complete draft measure packet – Energy Solutions
4. Measure review – Cal TF
5. Cal TF affirmation – Cal TF
6. Submit measure for CPUC approval – SCE

Once the Cal TF approves the measure for development, they will generate a blank measure packet shell in the eTRM. Energy Solutions will update the packet with the necessary measure package data. When complete, the Cal TF will review the measure packet for completeness and adherence to eTRM standards. Energy Solutions will resolve any requested edits. Once the review is complete, the MP will receive affirmation from the Cal TF, and this project will be considered complete. At this point, Southern California Edison (SCE), the lead IOU for this measure, will take assignment of the measure packet in the eTRM and submit it to the CPUC for the last step.

SCE will manage responses to comments, edit requests or questions from the CPUC review committee. Once the MP is approved by the CPUC, the measure will be published and publicly accessible in the eTRM.

Data Collection

The project team collected new cooktop performance data to update the data set for the MP, adding the new data to existing cooktop measure SWFS026 data to provide calculations with a larger set of market data. We gathered new cooktop performance test data from Frontier Energy and SCE and collected additional product cost data by web-scraping pricing data from industry-leading online equipment suppliers. Cooktop cost and performance data has been aggregated and incorporated into a supporting document that also includes the data required for energy modeling and calculating incremental measure costs.

Fuel Substitution Calculations

We modified existing measure energy models to adapt to fuel substitution calculations. The models were used to estimate the average energy use for natural gas and electric offerings and used the existing field and new lab data sets. We used the CPUC Fuel Substitution calculator, RACC-FSC_3.0, to calculate values required for fuel substitution measures.

Measure Characterization

Energy Solutions has developed the language necessary to complete all required sections of the eTRM measure characterization, including formulas and inputs.

Findings

Measure Package Input Data

The initial task for the measure development was to collect performance test data to determine the energy consumption of baseline and measure cooktops. The performance data from the existing measure package SWFS026 developed in 2023 was combined with the new data collected through July of 2024 for the fuel-substitution measure. A comparison of the performance data from the existing measure to the combined performance data of the new fuel-substitution measure reveals that efficiencies of both baseline and measure equipment have increased slightly. The baseline gas cooktop average efficiency increased by 1.3 percent and the measure electric efficiency increased by 1.7 percent.

All cooktop models included in the new measure package were tested on a per-burner basis according to ASTM-1521, the industry-standard testing methodology used for determining cooking efficiency, production capacity, and gas pilot rate. The results of this testing provide the information needed to determine which equipment met base-case or measure-case requirements. The measure case is defined as an electric cooktop evaluated under ASTM Standard F1521 that tests as having a cooking efficiency greater than or equal to 81 percent. The parameters for base-case equipment were derived from the results of gas cooktop equipment tested, which did not meet the gas measure-case cooking efficiency specification of greater than or equal to 43 percent. These are the same requirements being used in the existing measure case SWFS026.

Performance test data of 44 gas baseline models and 54 measure-case electric models was gathered from the California Energy Wise (CEW) Qualified Products List (QPL), Frontier Energy's Food Service Technology Center, SoCal Edison's Foodservice Technology Center and from the existing measure SWFS026. The data was categorized as baseline or measure and averaged for use in energy modeling. Average values are listed in 1.

Table 1: Average Cooktop Performance Data

Average Values	Cooking Efficiency	Production Capacity (lb/h)	Per Burner Pilot Rate (Btu/hr)
Electric (measure)	86%	57.6	N/A
Gas (baseline)	35%	78.4	508.2

The project team researched materials and labor costs for both base and measure cases to establish incremental measure costs (IMC). Cooktop material costs were determined by performing online research of major foodservice equipment retailers in Q2 of 2024. We collected costs for 44 electric and 93 gas cooktops and used them to establish the IMC. The models were categorized as either baseline or measure depending on their inclusion on the California Energy Wise QPL, or their laboratory-tested efficiency rating. Labor costs were determined by analyzing data from RSMeans Online quoting software. The labor costs associated with installing a new gas and electric cooktop were found by obtaining estimates from six major cities in California. Those estimates were averaged to obtain labor costs for installing a new gas base case or electric measure-case cooktop and are listed in Table 2.

Table 2: Incremental Measure Cost

Category	Material Cost per Burner	Labor Cost per Burner	Total
Gas (Baseline)	$708	$35	$743
Electric (Measure)	$1,403	$47	$1,451
Incremental Measure Cost (IMC)	$695	$13	$708

When removing a gas cooktop and replacing it with an electric model, additional infrastructure may be required to supply electricity to the appliance. A new electrical receptacle, wiring, and labor to install them and cap the existing gas line may be needed. Research was performed on RSMeans Online to get the material and labor costs required to perform that work. For a normal replacement installation, the infrastructure costs will be added to the electric measure-case material and labor costs. The estimated labor and material costs for this additional work are listed in Table 3.

Table 3: Infrastructure Materials and Labor

Category	Material Cost per Burner	Labor Cost per Burner	Total
Electric infrastructure	$239	$44	$284

Fuel Substitution Calculations

The calculations for Commercial Cooktop Fuel Substitution energy savings are adapted from the SWFS026 energy-savings formulas shown in 14. The baseline gas appliance daily energy use consists of cooking energy plus pilot energy while the daily electric induction measure energy use includes cooking energy only. Total annual energy consumption is calculated as the daily energy consumption times the number of operating days per year. The annual savings values will be used for the savings numbers in the measure permutations.

Table 4: Energy Consumption Formulas

Parameter	Equation10
Gas cooking energy (baseline)	$\frac{constCalc\_lbs\_day \bullet constCalc\ Btu\_lb}{gasBase\ cookEff}$
Pilot energy rate (Btu/hr)	$gasBase\ pilotBtuh \bullet \left(CFac\ hr\_day - \frac{ConstCalc\_lbs\_day}{gasBase\_prodCap}\right)$
Electric cooking energy (measure)	$\frac{constCalc\ lbs\_day \bullet Round\left(\frac{constCalc\_Btu\_lb}{CFac\_Btu\_kWh}, 3\right)}{elecMeas\_cookEff}$

To find annual gas cooktop energy consumption, input values for each of the formula's variables and constants needed to be determined. For cooking efficiency, pilot energy, and production capacity, the values were taken from the averaged performance data shown in 1. The constants for pounds of food cooked per day, operating days per year, and the ASTM energy-to-food ratio were taken from values used in the existing cooktop measure SWFS026. To establish total annual gas unit energy consumption, we combined cooking energy and pilot energy.

Table 5: Baseline Gas Cooktop Consumption per Burner

Parameter	Baseline Gas Burner
Cooking energy efficiency	35%
Pilot energy rate (Btu/hr)	508
Production capacity (lb/hr)	78
Pounds of food cooked per day (lb)	129
ASTM energy-to-food (Btu/lb)	130
Operating days/year (days)	326

Parameter	Baseline Gas Burner
Btu-to-therm conversion	100,000
Daily pilot energy consumption (Btu)	11,362
Daily cooking energy consumption (Btu)	47,216
Daily energy consumption (Btu)	58,577
Annual energy consumption (therms)	191
Annual energy consumption (kWh)	5,595

To find electric cooktop energy consumption, input values for each of the formula's variables and constants were obtained from the same sources as the gas cooktop values. The cooking efficiency value is based on the average of lab test data as shown in Table 4 and the constants for pounds of food cooked per day, operating days per year, and the ASTM energy-to-food ratio were obtained from references in SWFS026.

Table 6: Measure Electric Cooktop Consumption per Burner

Parameter	Measure-Case Model
Cooking energy efficiency	86%
Pounds of food cooked per day (lb)	129
ASTM energy-to-food (Wh/lb)	38
Operating days/year (days)	326
Daily cooking energy consumption (Wh)	5,674
Annual energy consumption (kWh)	1,850

As shown in Table 5 and Table 6, there is a sizable difference in the calculated annual energy consumption of gas and electric cooktops. When annual energy use is compared side by side, energy consumption is reduced by 67 percent when converting from gas to electric fuel. Due to the nature of fuel substitution, there is an increase in electric energy consumption. However, that increase is offset by the elimination of natural gas consumption and the use of high-efficiency electric models in place of low-efficiency gas models.

For the fuel substitution test, the energy consumption units of measurement for both fuel types were converted to million British thermal units (MMBtu) to calculate the total energy savings in the fuel conversion. The combined Refrigerant Avoided Cost Calculator and Fuel-Substitution Calculator (RACC-FSC_v3.0_DRAFTrev4.xlsx) was used for the fuel-substitution test to comply with fuel-substitution measure development requirements. The requirements state that fuel-substitution measures must not increase total source energy consumption nor adversely impact the environment when compared to the baseline measure utilizing the original fuel. The Commercial Cooktop Fuel Substitution measure parameters were entered into the calculator and passed the requirements on the FSC tab.

Measure Characterization

We are adapting the existing cooktop measure characterization, SWFS026, into the new Commercial Cooktop Fuel Substitution measure in accordance with the guidelines listed in the TRM Measure Characterization Template as well as the eTRM Style Guide. Edits to boilerplate language and characterization details are included in the updated measure characterization. The project team referenced the Fuel Substitution Technical Guide for the calculation methodology and the presentation of the findings. All sections of the measure characterization and reference materials — including calculation methodology, equipment cost, and performance data — have been completed and a draft copy has been sent to SCE for review.

Summary

This project incorporated the research and calculations required to develop a new Commercial Cooktop Fuel Substitution measure for use in the California eTRM. The measure will supplement the existing Commercial Cooktop measure SWFS026 by providing an option to switch fuels from natural gas to electricity.

To create the measure, updated cooktop performance data was collected and combined with existing data to create a new dataset for use in energy consumption calculations. The average efficiencies of 35% for natural gas and 86% for electric produce significant savings when calculating annual energy consumption. Switching from natural gas to electric fuel results in a reduction of the equivalent of 3,745 kWh per burner. Actual operating costs associated with fuel substitution are dependent on the price of natural gas and electricity. New material and labor costs were gathered to update incremental measure costs for the replacement of natural gas cooktop with electric cooktops. Infrastructure material and labor costs were collected to account for additional costs incurred in retrofit applications.

The Commercial Cooktop Fuel-Substitution measure will incentivize electric cooktops through the California Instant Rebates midstream foodservice program and investor-owned utility (IOU) downstream programs. The measure will improve adoption of high efficiency electric cooktops and promote electrification of the foodservice industry.