Work Paper SCE13CC002

**Revision 2**

**Southern California Edison**

**Commercial Electric Steamers**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | FS-38502 |
| **Measure Description** | High efficiency commercial electric steam cooker |
| **Base Case Description** | Standard efficiency commercial electric steam cooker |
| **Units** | Unit |
| **Energy Savings** | Refer to Excel Calculation Attachment |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Effective Useful Life** | Cook-ElecStmCooker: 12 years |
| **Measure Installation Type** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratio** | Com-Default>2yrs: 0.6 |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 5/30/2012 | Ricson Chude/SCE | Updates from WPSCNRCC002.2:   * Removed 30% reduction factor as measure is non-HIM * Updated Cost and Savings calculation based on ASTM testing * Updated NTG values to DEER 2011 |
| 1 | 5/8/2014 | Chris Kuch/SCE | -Work paper updated for the reporting period, effective 7/1/14 – 12/31/14.  -Work paper and measure names have been changed.  -Savings have been updated. |
| 2 | 01/14/2016 | Ajay Wadhera/Solaris | -Work paper template update  -Revision update for 2016 program year |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
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Cal TF website: <http://www.caltf.org/>

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

This work paper details the replacement of a standard efficiency commercial electric steam cooker (steamer) with a high efficiency commercial electric steamer. The high efficiency steamer is usually a boilerless and connectionless steamer.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | High efficiency commercial electric steamer |
| Existing Condition | Standard commercial electric steam cooker |
| Code/Standard | N/A |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
| N/A | N/A | FS-38502 | N/A | Commercial Electric Steamer |

Qualifying steamers must meet the following requirements:

* Meet ENERGY STAR® specifications for energy efficiency or must have a tested heavy load potato cooking energy efficiency of ≥ 50%, utilizing American Society for Testing and Materials (ASTM) Standard F1484 [137].
* Be listed on the Food Service Technology Center pre-approved list.

## 1.2 Technical Description

Steam cookers (steamers) provide a fast cooking option for preparing large quantities of food while retaining vital nutrients in the cooked product. In addition, steamers can be used to gently heat food products. Steamers come in a variety of configurations, including countertop models, wall mounted models and floor models mounted on a stand, pedestal or cabinet style base. A steamer may consist of one to four stacked cavities, though two compartment steamers are the most prevalent in the industry. The cavity is usually designed to accommodate a standard 12" x 20" hotel pan.

The steam itself can be produced several ways. Many compartment steamers have an external (with respect to the cooking compartment) gas, electric, or service steam powered boiler that produces potable steam under pressure. This pressurized steam is delivered to the cooking compartment as demanded by the control settings. However, in the case of a pressureless steamer, the compartment is openly connected to a condensate drain, and the steam environment within the compartment cannot sustain a pressure above atmospheric (both raw steam and condensate exit the cooking cavity through this drain).

Steam also may be produced by a steam generator located within (or directly connected to) the cooking cavity. This method differs from the boiler based steamers in that the steam is produced at (or slightly above) the compartment operating pressure (i.e., atmospheric pressure). This strategy is not used for pressure steamers. A steamer may produce steam by boiling water poured directly into the cooking compartment prior to operation (this is the simplest form of an internal steam generator, typically referred to as a “connectionless” steamer). The electric or gas heaters are typically located directly beneath the compartment’s floor [138].

With the availability of ENERGY STAR® rated models of steam cookers, it is fairly straightforward to differentiate between high efficiency and standard efficiency models. Steamer performance is determined by applying the ASTM Standard Test Method for the Performance of Steam Cookers (F1484). The ASTM standard test method is considered to be the industry standard for quantifying the efficiency and performance of steamers.

## 1.3 Installation Types and Delivery Mechanisms

The delivery method is Financial Support - Down-Stream Incentive – Deemed

The install type is ROB (Replace on Burnout).

Since there are no EM&V studies on the useful life of steamers, and since it is standard practice in the commercial foodservice industry to purchase equipment only when it is needed (e.g. replacement or additional capacity), this measure is focused on ROB applications only.

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Replace on Burnout (ROB) | Above Code or Standard | N/A | EUL | N/A |

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings.

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Down-Stream Incentive | The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

The DEER2014 database does not contain the measure in this work paper.

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| 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 | N/A |
| Reason for Deviation from DEER | Measure not available in DEER |
| DEER Measure IDs Used | N/A |

**Net-to-Gross Ratio**

The NTG values were obtained using the DEER READI tool. The relevant NTG values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| Com-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Com | Any | Any | 0.6 |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| Cook-ElecStmCooker | Non-Residential | Cooking | Steam Cooker (electric) | 12 | N/A |

### 1.4.2 Codes and Standards Analysis

This measure is not governed by either state or federal codes and standards.

The ASTM Standard Test Method for thePerformance of Steam Cookers (F1484) is applicable for estimating energy use and cooking performance. It was used to estimate the energy consumption of the base case and measure equipment.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| N/A | N/A | N/A |

## 1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

### 1.5.1 Non-DEER Study Review

The Commercial Cooking Appliance Technology Assessment from Fisher Nickel [138] was referenced.

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

## 2.1 Electric Energy Savings Estimation Methodologies

This work paper uses the industry standard ASTM Standard Test Method for thePerformance of Steam Cookers (F1484) for calculation of energy use and demand, based on testing in an approved and qualified laboratory. In the absence of mandatory regulations for testing commercial steamers, there is little incentive for equipment manufacturers to have their baseline equipment tested. Therefore, the ASTM performance parameters for baseline equipment were drawn from a sample of economy grade equipment tested by the Food Service Technology Center. The measure case data were drawn from the list of commercial steamers that have been tested by IOU testing laboratories. The averages are summarized in table shown below.

ASTM Test Results for Steamers

|  |  |
| --- | --- |
| **Steamer** | **Cooking-Energy Efficiency\*** |
| Baseline commercial steamers | 26% |
| Energy efficient commercial steamers | 68% |

\*Based on the heavy-load potato test in ASTM F1484.

Table below shows an example savings calculation. See Attachment 1 for a full list of savings.

Example Steamer Savings Calculation

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy Efficient Model** |
| Pan Capacity | 6 | 6 |
| Preheat Time (min) | 15 | 15 |
| Preheat Energy (kWh) | 1.50 | 1.50 |
| Idle Energy Rate (kW) | 1.00 | 0.26 |
| **Cooking-Energy Efficiency (%)** | **26%** | **68%** |
| Production Capacity (lb/h) | 70 | 88 |
| Average Water Consumption Rate (gal/h) | 40 | 2 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats/Day | 1 | 1 |
| Pounds of Food Cooked per Day | 100 | 100 |
| Electric Cost ($/kWh) | $0.13 | $0.13 |
| Water/Sewer Cost ($/CCF) | $5.00 | $5.00 |
| ASTM Energy to Food (kWh/lb) | 0.0308 | 0.0308 |
| Percentage of Time in Constant Steam Mode | 0.90 | - |
| Daily Energy Consumption (kWh) | 91.4 | 8.8 |
| Average Demand (kW) | 7.6 | 0.7 |
| Estimated Demand Reduction (kW) | - | 6.9 |
| **Final Estimated Demand Reduction (kW)** | **-** | **6.2** |
| Annual Energy Consumption (kWh) | 33,364 | 3,208 |
| **Estimated Energy Savings (kWh/yr)** | **-** | **30,156** |
| Annual Water Consumption (gal) | 175,200 | 8,760 |
| Estimated Water Savings (gal) | - | 166,440 |
| Annual Energy Cost ($) | $4,337 | $417 |
| Estimated Cost Savings ($/yr) | - | $3,920 |
| Annual Water Cost ($/yr)\* | $1,171 | $59 |
| Estimated Water Cost Savings ($/yr)\* | - | $1,113 |

\*Water and wastewater cost are based on a rate of $2.00/CCF water and $3.00/CCF wastewater. (1 CCF = 748 gallons)

**Daily Energy Consumption Calculation and Definitions**

Where:

|  |  |
| --- | --- |
| Eday = | Daily Energy Consumption (kWh) |
| LBfood = | Pounds of Food Cooked per Day |
| Efood = | ASTM Energy to Food (kWh/lb) = kWh/pound of energy absorbed by food product during cooking |
| Efficiency = | Heavy Load Cooking Energy Efficiency % |
| Idle Rate = | Idle Energy Rate (kW) |
| TON = | Operating Hours/Day |
| PC = | Production Capacity (lbs/hr) |
| TP = | Preheat Time (min) |
| % Steam = | Percentage of Time in Constant Steam Mode |
| EP = | Preheat Energy (kWh) |

## 2.2. Demand Reduction Estimation Methodologies

A steamer’s actual contribution to a building’s peak demand may vary significantly depending on its 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 that the building peak is set is significantly higher than for any other input rate for that appliance. Therefore, it has been assumed that the probable contribution to the building’s peak demand is equal to the appliance’s average demand.

A coincidence factor of 0.9 from DEER 2005 [26] is applied to demand reduction; see in section 2.1 for final values.



DEER 2005 Cooking Coincidence Factor

# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Education - Community College | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Education - Primary School | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Education - Secondary School | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Education – University | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Health/Medical - Nursing Home | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Lodging – Hotel | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Lodging – Motel | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Manufacturing - Bio/Tech | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Manufacturing - Light Industrial | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Office – Large | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Restaurant - Fast-Food | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Restaurant - Sit-Down | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Retail - Multistory Large | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Grocery | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Health/Medical - Hospital | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |
| Retail - Small | DEER:Indoor\_Non-CFL\_Ltg | NON\_RES |

Commercial steamer load shapes differ among food service facilities (quick service, casual dining, hotels, college, schools, hospitals, etc.) depending on daily menu variations, hours of operation, serving periods, day-of-week, and facility location (city downtown, suburban mall, access to interstate highways, etc.). Consequently, applicable average TOU and hourly load shapes for steamers are unavailable. The ASTM Standard Test Method used to generate energy use data is based on hours of use and operating state (preheat, idle, and heavy-load cooking). Generally, steamers are used to prepare food within a few hours before it is served, unless the operation is steaming items to order (e.g., seafood), so loads may not necessarily be coincident with regular meal periods (breakfast, lunch, and dinner). Between meal periods steamers may be used to prepare ingredients for either the next meal period.

# Section 4. Costs

High efficiency steamers typically list for more than standard efficiency steamers. However, high efficiency designs are often bundled with other features such as all stainless steel construction and high quality components and controls.

Equipment prices for this work paper were compiled from a number of sources including quotes, equipment sales representatives, and manufacturer sources. Since equipment pricing in food service is closely held information and prices vary widely according to buying volume and other factors, the sources for prices cannot be listed explicitly.

## 4.1 Base Case Cost

Base case costs are calculated by applying an industry-standard 50% discount to manufacturer published list prices. It is assumed that the labor cost is the same in base and measure cases, so only equipment costs are presented here.

## 4.2 Measure Case Cost

Measure case costs are calculated by applying an industry-standard 50% discount to manufacturer published list prices.

## 4.3 Full and Incremental Measure Cost

Incremental Cost

|  |  |
| --- | --- |
|  | **Cost** |
| Energy Efficient Average List Price | $15,189 |
| Baseline Average List Price | $10,925 |
| Energy Efficient Average Cost (50% of List Price) | $7,594 |
| Baseline Average Cost (50% of List Price) | $5,463 |
| **Incremental Measure Cost** | **$2,132** |

**Full and Incremental Measure Cost Equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | (MEC + MLC) – (BEC + BLC) | (MEC + MLC) – (BEC + BLC) | N/A |
| NEW/NC |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| Commercial Electric Steamer | ROB | $2,132 | $2,132 | N/A |

# Attachments

1. Savings Calculations



# References



|  |  |
| --- | --- |
| [26] | 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study - Final Report - Itron Inc. - Dec. 2005 |
| [137] | Standard Test Method for the Performance of Steam Cookers. |
| [138] | Commercial Cooking Appliance Technology Assessment |