**Work Paper SCE13CC002**

**Revision 1**

**Southern California Edison Company**

**Commercial Electric Steamers**

# At-a-Glance Summary

|  |  |
| --- | --- |
| ****Applicable Measure Codes:**** | *FS-38502* |
| **Measure Description:** | High efficiency commercial electric steam cooker |
| **Base Case Description:** | Standard efficiency commercial electric steam cooker |
| **Energy Impact Common Units:** | Per unit |
| **Energy Savings :** | Refer to Excel Calculation Attachment |
| **Gross Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Measure Incremental Cost ($/unit):** | Refer to Excel Calculation Attachment |
| **Effective Useful Life (years):** | Cook-ElecStmCooker: 12 years |
| **Measure Application Type:** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratios:** | Com-Default>2yrs: 0.6 |
| **Important Comments:** | This work paper document does not contain a data set in conformance with the 4/1/14 CPUC Ex Ante Database Specification; SCE will provide that data set separately. |

# Document Revision History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Workpaper and Revision # | Tech. Revision | MM/DD/YY | Author/Affiliation | Summary of Changes |
| SCE13CC002.0 | No | 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 |
| SCE13CC002.1 | Yes | 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. |

# 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.

Table 1 Measure Names

|  |  |
| --- | --- |
| Solution Code | Measure name |
| FS-38502 | 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 Measure Application Type

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.

## 1.4 Measure and Base Case Cost Effectiveness Data

### 1.4.1 DEER Measure and Base Case Analysis

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

Table 2 DEER Difference Summary

|  |  |
| --- | --- |
| DEER Difference Summary Table | |
| Modified DEER Methodology | No |
| Scaled DEER Measure | No |
| DEER Building Prototypes Used | No |
| Deviation from DEER | DEER does not contain this type of measure. |
| DEER Version | N/A |
| DEER Run ID and Measure Name (Sample) | N/A |

**Net to Gross**

The NTG value was obtained from the “DEER2011\_NTGR\_2012-05-16.xls” on the DEER website as required by Version 5 of the California Public Utilities Commission (CPUC) Energy Efficiency Policy Manual [351]. The relevant NTGR for this measure is shown in Table 3 below.

Table 3 Net-to-Gross Ratio

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NTGR\_ID\* | Description\* | Sector\* | BldgType\* | ProgDelivID | NTG\* |
| 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 |

\*Denotes that the column is taken from the DEER NTG Table.

**Installation Rate**

The installation rate (IR) is identified in the calculation attachment. This value is obtained from the support table available in READi. Currently there is no versioning on the installation rate table. To address appropriate selection of the installation rate the date of the workpaper will serve as the last date checked for updated IR values. The installation rate varies by end use, sector, technology, application, and delivery method. The relevant IR values for this measure are shown in Table 4 below.

Table 4 Installation Rate

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

**Spillage Rate**

Spillage rate will also be applied to measures however the values will not be tracked in the workpapers. The spillage rate will be tracked in an external table to be supplied to the Energy Division.

**READi Technology Fields**

To support the development of the ED ex ante tables, select fields from the ex ante database will be identified in the workpaper. For a full set of values associated with the measures in the workpaper refer the Excel calculation template. (In the event that the READi IDs do not support the technology in this workpaper simply indicate “Non-DEER”.)

Table 5 READi Tech IDs

|  |  |
| --- | --- |
| READi Field Name | Values included in this workpaper |
| Measue Case UseCategory | FoodServ |
| Measure Case UseSubCats | Cooking |
| Measure Case TechGroups | FoodService |
| Measure Case TechTypes | Steamer |
| Base Case TechGroups | FoodService |
| Base Case TechTypes | Steamer |

### 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.

Table 6 Code Summary

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

### 1.4.3 Non-DEER Study Review

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

### 1.4.4 Measure and Base Case Effective Useful Life

DEER14 update documentation provides EUL and RUL information to be used for the 2015 program cycle extension on [www.deeresources.com](http://www.deeresources.com). The DEER documentation “DEER2014-EUL-table-update\_2014-02-05.xlsx” provides the RUL value as a flat 1/3 of the EUL value. The RUL value will only be applied to the first baseline period for retrofit measures that have applicable code that will affect the energy savings. In all other installation types and retrofit with no applicable code that affects the energy savings, the RUL is not applicable to either the first or second baseline period.

To obtain the EUL value the DEER14 update documentation, “DEER2014-EUL-table-update\_2014-02-05.xlsx” [436], was consulted. Table 7 below identifies the value/methodology used for the measures in this work paper.

Table 7 DEER14 EUL Value/Methodology

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| READi EUL ID | Market | Enduse | Measure | EUL (Years) | RUL (Years) |
| Cook-ElecStmCooker | Non-Residential | Cooking | Steam Cooker (electric) | 12 | N/A |

# Section 2. Energy Savings & Demand Reduction Calculations

## 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 8.

Table 8 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 9 shows an example savings calculation. See Attachment 1 for a full list of savings.

Table 9 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 Table 9 for final values.



Figure 1 DEER 2005 Cooking Coincidence Factor

# Section 3. Load Shapes

The closest load shape chosen for this measure is the DEER:Indoor\_Non-CFL\_Ltg load shape. See the KEMA report [31] for a more thorough discussion regarding the load shapes for this measure.

Table 10 Building Types and Load Shapes

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

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. Base Case & Measure 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.

## 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.

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.

## 4.2 Measure Case Cost

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

## 4.3 Gross Measure Cost

For ROB measures, assuming the labor cost is the same in base and measure cases, the gross measure cost is determined using the following equation:

*Gross Measure Cost = Measure Case Material Cost – Base Case Material Cost*

Table 11 shows the calculation of gross measure cost:

Table 11 Gross and 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 |
| **Gross and Incremental Measure Cost** | **$2,132** |

## 4.4 Incremental Measure Cost

The incremental cost is the same as the gross measure cost and is shown in Table 1.

# Attachments

1. 

# References



|  |  |
| --- | --- |
| [26] | 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study - Final Report - Itron Inc. - Dec. 2005 |
| [31] | Load Shape Update Initiative - KEMA / JJ Hirsch and Assoc. / Itron Inc. - November 17, 2006 |
| [137] | Standard Test Method for the Performance of Steam Cookers. |
| [138] | Commercial Cooking Appliance Technology Assessment |
| [351] | Energy Efficiency Policy Manual-Version 5 |
| [436] | 2014 DEER EUL Table - Update |

# Appendix A – SCE/ED Application Types

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SCE Program Type | ED Application Type | 1st Baseline Savings | 2nd Baseline Savings | 1st Baseline Cost | 2nd Baseline Cost | 1st Baseline Life | 2nd Baseline Life |
| New | New Construction (Nc) | Above Code/Standard | N/A | Incremental Cost | N/A | EUL | 0 |
| Replace on Burnout (ROB) | Replace on Burnout (Rob)/Normal Replacement (NR) | Above Code/Standard | N/A | Incremental Cost | N/A | EUL | 0 |
| Retrofit (RET) | Early Replacement (ER) | Above Cust. Existing | Above Code/Standard | Full Cost | Incremental Cost | RUL | EUL-RUL |
| Retrofit – First Baseline Only (REF) | Early Replacement RUL (ErRul) | Above Cust. Existing | N/A | Full Cost | N/A | EUL | 0 |
| Retrofit Add-on (REA) | N/A | Above Cust. Existing | N/A | Full Cost | N/A | EUL | 0 |