#### Work Paper PGECOFST104

#### Commercial Steam Cooker

**Revision # 6**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Commercial Steam Cooker-Electric and Gas** Measure Codes F108, F109

# At-A-Glance Summary — Commercial Steam Cookers

|  |  |  |
| --- | --- | --- |
| **Applicable Measure Codes:** | **F108** | **F109** |
| **Measure Description:** | Commercial Steam Cooker (Electric) | Commercial Steam Cooker (Gas) |
| **Energy Impact Common Units:** | Per Unit / Steam Cooker | Per unit / Steam Cooker |
| **Base Case Description:** | Source: PG&E Calculations  Existing Electric Steam Cooker | Source: PG&E Calculations Existing Gas Steam Cooker |
| **Base Case Energy Consumption:** | Source: PG&E Calculations 33,364 kWh/yr. | Source: PG&E Calculations 3,942 Therms/yr. |
| **Measure Energy Consumption:** | Source: PG&E Calculations 3,208 kWh/yr. | Source: PG&E Calculations 235 Therms/yr. |
| **Energy Savings (Base Case – Measure)** | Source: PG&E Calculations 30,156 \*0.7= **21,109** kWh/yr. | Source: PG&E Calculations 3,707\*0.7= **2595** Therms/yr. |
| **Costs Common Units:** | Source: PG&E Calculations $ per Steam Cooker | Source: PG&E Calculations $ per Steam Cooker |
| **Base Case Equipment Cost ($/unit):** | Source: PG&E Calculations $5463 | Source: PG&E Calculations $8636 |
| **Measure Equipment Cost ($/unit):** | Source: PG&E Calculations $7594 | Source: PG&E Calculations $11537 |
| **Measure Incremental Cost ($/unit):** | Source: PG&E Calculations $2131 | Source: PG&E Calculations $2901 |
| **Effective Useful Life (years):** | **12 years**  (DEER EUL\_ID: Cook- ElecStmCooker)  Source: [www.Deeresources.com](http://www.Deeresources.com) | **12 years**  (DEER EUL\_ID: Cook- GasStmCooker)  Source: [www.Deeresources.com](http://www.Deeresources.com) |
| **Program Type:** | Replace on Burnout (ROB), and New Construction (NC). | Replace on Burnout (ROB), and New Construction (NC). |
| **Net-to-Gross Ratios:** | **0.6** (DEER NTGR ID: Com-Default>2yrs)  Source: DEER 2016 | **0.6** (DEER NTGR ID: Com-Default>2yrs)  Source: DEER 2016 |
| **Important Comments:** |  |  |

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# Document Revision History

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Revision #** | | **Date** | **Description** | | **Author (Company)** | |
| Revision 0 | | 12/11/2007 | Original work paper: Commercial Steam Cooker PGECOFST104 R0.doc | | David Zabrowski (Fisher-Nickel, inc.) | |
| Revision 1 | | 6/1/2009 | Changes to EUL, NTG language and references, costs updated | | David Zabrowski, Lauren Mills (Fisher-Nickel, inc.), Steve Blanc PG&E | |
| Revision 2 | | 3/31/2010 | Updated pricing and incremental cost, Update to DEER 2009-11 NTG file | | David Zabrowski (Fisher-Nickel, inc.), Steve Blanc PG&E | |
| Revision 3 | | 7/15/2010  7/17/2011 | Revised EUL and NTG language per ED comments, incorporated 30% UES reduction in savings | | Charlene Spoor (PG&E) | |
| Revision 4 | | 05/22/2012  8/22/2012 | Updated NTG, EUL and savings analysis, pricing and incremental costs.  Updated BLD, CZ and VIN to ANY per READI requirements | | Kong Sham (Fisher-Nickel, Inc.)  Charlene Spoor (PG&E)  Charlene Spoor (PG&E) | |
| Revision 5 | | 04/23/3014 | New template format | | Charlene Spoor (PG&E) | |
| Revision 6 | 03/24/2016 | | | Updated new format | | Denis Livchak (Fisher-Nickel, Inc.) |
| Revision 6 | 8/8/2016 | | | The 30% UES reduction was dropped and it is incorporated in this revision. Updated calc tables to match online calculator ; updated formulas and incorporated examples | | Alina Zohrabian (PG&E)  Mini Damodaran (PG&E) |

# Table of Contents

[At-A-Glance Summary — Commercial Steam Cookers ii](#_Toc458777543)

[Document Revision History iii](#_Toc458777544)

[Table of Contents iv](#_Toc458777545)

[List of Tables v](#_Toc458777546)

[Section 1. General Measure & Baseline Data 6](#_Toc458777547)

[1.1 Product Measure Description & Background 6](#_Toc458777548)

[1.2 Product Technical Description 7](#_Toc458777549)

[1.3 Measure Application Types 7](#_Toc458777550)

[1.4 Product Base Case and Measure Case Data 8](#_Toc458777551)

[1.4.1 DEER Base Case and Measure Case Information 8](#_Toc458777552)

[1.4.2 Codes & Standards Requirements Base Case and Measure Information 9](#_Toc458777553)

[1.4.3 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information 9](#_Toc458777554)

[1.4.4 Assumptions and Calculations from other sources – Base and Measure Cases 9](#_Toc458777555)

[1.4.5 Time of use Adjustment Factor 11](#_Toc458777556)

[Section 2. Calculation Methods 11](#_Toc458777557)

[2.1 Electric Energy Savings Estimation Methodologies 13](#_Toc458777558)

[2.2 Demand Reduction Estimation Methodologies 14](#_Toc458777559)

[2.3 Gas Energy Savings Estimation Methodologies 15](#_Toc458777560)

[Section 3. Load Shapes 17](#_Toc458777561)

[3.1 Base Case Load Shapes 17](#_Toc458777562)

[3.2 Measure Load Shapes 17](#_Toc458777563)

[Section 4. Base Case & Measure Costs 18](#_Toc458777564)

[4.1 Base Cases Costs 18](#_Toc458777565)

[4.2 Measure Costs 18](#_Toc458777566)

[4.3 Incremental & Full Measure Costs 18](#_Toc458777567)

[References 21](#_Toc458777568)

# List of Tables

[Table 1. Energy Efficiency Requirements for Commercial Steam Cookers 6](#_Toc458777569)

[Table 2. Measure Application Type 7](#_Toc458777570)

[Table 3. DEER 2016 Net-to-Gross Ratios 8](#_Toc458777571)

[Table 4. DEER Effective Useful Life 8](#_Toc458777572)

[Table 5. Installation Rate 9](#_Toc458777573)

[Table 6. ASTM test results for Baseline Commercial Steam Cookers 10](#_Toc458777574)

[Table 7. ASTM test results for Energy Efficient Commercial Steam Cookers 10](#_Toc458777575)

[Table 8. Field Monitoring Results Summary 10](#_Toc458777576)

[Table 9. Hours of Operation 11](#_Toc458777577)

[Table 10. Final claimable savings 12](#_Toc458777578)

[Table 11. Commercial Electric Steam Cooker Cost Effectiveness Example 13](#_Toc458777579)

[Table 12. Commercial Gas Steam Cooker Cost Effectiveness Example 15](#_Toc458777580)

[Table 13. Equipment Incremental Cost Data for Energy Efficient Commercial Steam Cookers 18](#_Toc458777581)

# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

This work paper documents the rationale for the Energy Efficient Commercial Steam Cooker (Electric and Gas) measures as listed in the Commercial Food Service Catalog. The Commercial Food Service Catalog is part of Pacific Gas and Electric Company’s Customer Energy Efficiency Program. PG&E offers incentives to non-residential customers for installing qualifying lighting, refrigeration, air-conditioning, food service, and agricultural equipment.

***Catalog Description –***

**F108:** The commercial steam cooker must meet ENERGY STAR® specifications for energy efficiency or must have a tested heavy load potato cooking energy efficiency of 50% utilizing ASTM Standard F1484[[1]](#endnote-1).

**F109:** The commercial steam cooker must meet ENERGY STAR® specifications for energy efficiency or must have a tested heavy load potato cooking energy efficiency of 38% utilizing ASTM Standard F1484.

**SCE 1, SCE 2, SCG 1, and SCG2:** Southern California Gas and Electric will be further separating out the measure sizes for their programs.

***Program Restrictions and Guidelines***

***Terms and Conditions***

This measure includes new commercial steam cookers that are ENERGY STAR®[[2]](#endnote-2) qualified or meet the qualifications listed in Table 1. The qualifications were developed by the California Investor Owned Utilities: <http://www.fishnick.com/saveenergy/rebates/2015_CFS_Rebate_Criteria-updated_20150714.pdf>. Used or rebuilt equipment is not eligible. Customers must provide proof that the appliance has a cooking-energy efficiency that meets the requirements listed below.

The rebate for F108 and F109 is downstream, provided to the customer at the time of sale, upon receipt of application and invoice. This is not a direct install program.

Table 1. Energy Efficiency Requirements for Commercial Steam Cookers

|  |  |  |
| --- | --- | --- |
| **Measure Code** | **Steam Cooker Type** | **Cooking-Energy Efficiency\*** |
| F108 | Electric Steam Cookers | ≥ 50% |
| F109 | Gas Steam Cooker | ≥ 38% |

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

***Market Applicability***

This measure is applicable to any commercial cooking application, including (but not limited to) casual dining and quick service restaurants, hotels, motels, schools, colleges and recreational facilities.

## 1.2 Product 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 pressure less 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.

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 Types

Table 2. Measure Application Type

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ER | Early retirement | *measure applied while existing equipment still viable, or retrofit of existing equipment* |
| ROB | Replace on Burnout | *measure applied when existing equipment fails or maintenance requires replacement* |
| NC | New Construction | *measure applied during construction design phase as an alternative to a code-compliant standard design* |

Since there are no EM&V studies on the useful life of commercial steam cookers and 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 and NC applications only.

## 1.4 Product Base Case and Measure Case Data

### 1.4.1 DEER Base Case and Measure Case Information

The DEER database does not contain information on energy use or savings for an energy-efficient electric or gas commercial steam cooker measure. The only reference in DEER for Commercial cooking equipment is for Estimated Useful Life.

**Hours of Operation**

This measure would follow the hours of operation for quick serve and full serve restaurants as noted in the ASTM standards. For this measure annual hours of operation are considered 4380. Annual hours of operation were based on market based research in collaboration with the California Energy Commission found in Appendix E: <http://www.energy.ca.gov/2014publications/CEC-500-2014-095/CEC-500-2014-095.pdf> .

12 hrs /day \* 365 day/ yr = 4380 hrs

**Base Case & Measure Case Costs**

The base case and measure case costs are calculated are found in section 4.

***Net-to-Gross Assumptions***

**Net-to-Gross Assumption:** NTG values were downloaded and used directly from DEER.

DEER NTGR Values file does not specifically list commercial food service appliances. The default used for non-residential measures is 0.6[[3]](#endnote-3).

All applicable DEER based Net-to-Gross ratios for programs that may be used by this measure are listed below.

Table 3. DEER 2016 Net-to-Gross Ratios

|  |  |
| --- | --- |
|  |  |
| **NTG-ID** | **NTG** |
| **Com-Default>2yrs** | **0.6** |

**Effective Useful Life:**EUL values were downloaded and used directly from DEER.

DEER database shows a EUL of 12 years and an RUL of 4 years[[4]](#endnote-4) for all cooking appliance measures, including electric and gas commercial steam cookers.

Table 4. DEER Effective Useful Life

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Code** | **EUL (yrs)** | **RUL (yrs)** | **DEER Version** | **EULID** |
| F108 | 12 | N/A | DEER2014 | Cook- ElecStmCooker |
| F109 | 12 | N/A | DEER2014 | Cook- GasStmCooker |

**In Service Rate/ First Year 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.

Table 5. Installation Rate

|  |  |  |  |
| --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Com | 1 |

### 1.4.2 Codes & Standards Requirements Base Case and Measure Information

#### California Title 20

State of California Title 20 Appliance Efficiency Regulation[[5]](#endnote-5) has a category for cooking appliances, but commercial steam cookers are not included.

#### California Title 24

There are no State of California Title 24 Efficiency Regulation requirements for commercial steam cookers.

#### Federal

#### There are no Federal energy efficiency requirements for commercial steam cookers.

#### American Society for Testing and Materials (ASTM) Standards

#### ASTM Standard Test Method for the Performance 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.

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

There were no specific EM&V studies identified that addressed cooking measures in the commercial sector.

### 1.4.4 Assumptions and Calculations from other sources – Base and Measure Cases

This workpaper was developed using actual test data for this measure rather than using DEER data. The DEER calculations use a linear savings estimate based on the average production kW and Btu/h inputs of a standard and energy efficient steamers over a 12-hour day, 365 days per year as the bases of their savings calculations. This Work Paper is based on the calculation methods in ASTM Standard Test Method for thePerformance of Steam Cookers (F1484), which uses measured data under preheat, idle, and heavy-load cooking conditions. Savings calculations using this test method is detailed in section 1.4.4 of this work paper.

This Work Paper uses 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 steamer, there is little incentive on the part of 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 and is summarized in Table 6. The results are summarized in the Steamer Tech Assessment in Figure 8-6 of: <http://www.fishnick.com/equipment/techassessment/8_steamers.pdf> . The baseline steam cooker data is based on Gas Boiler Based Atmospheric steamers and Electric Steam Generator steamers.

Table 6. ASTM test results for Baseline Commercial Steam Cookers

|  |  |
| --- | --- |
| **Steamer Type** | **Cooking-Energy Efficiency\*** |
| Electric Steamers | 26% |
| Gas Steamers | 15% |

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

The measure case data was drawn from the list of commercial steamers that have been tested by IOU testing laboratories.

Table 7. ASTM test results for Energy Efficient Commercial Steam Cookers

|  |  |
| --- | --- |
| **Steamer Type** | **Cooking-Energy Efficiency\*** |
| Electric Steamers | 68% |
| Gas Steamers | 45% |

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

The Food Service Technology Center conducted an assessment of major commercial cooking appliance technologies, which included a chapter on steamer. Since commercial steamers are currently not covered by state or national codes, the base case for existing models of steamers was determined from the Food Service Technology Center assessment.

The Food Service Technology Center also conducted a field study[[6]](#endnote-6) documenting the real world differences in energy and water consumption differences between boiler-based and boiler less steamers throughout the state of California accounting for different climate zones and varying types of restaurants. The average energy consumption rate and water consumption rates are documented below. The water consumption results are taken from Table ES-1 <http://www.fishnick.com/publications/fieldstudies/Connectionless_Steamer_Field_Study_(revised).pdf>

Table 8. Field Monitoring Results Summary

|  |  |
| --- | --- |
| **Steamer Technology** | **Average Water Consumption (Gal/h)** |
| Boiler-based Steamers | 40.5 |
| Boilerless Steamers | 2 |

\**Based on Steamer Field Study Report performed by the Food Service Technology Center*

**Energy Savings Assumption (ΔW, ΔTherms):** *See section 2.2 and 2.3 for Electric and Gas savings calculations*

**Hours of Operation**: Calculations use a linear savings estimate based on the average production kW and Btu/h inputs of a standard and energy efficient steamers over a 12-hour day, 365 days per year as the bases of their savings calculations.

Table 9. Hours of Operation

|  |  |  |
| --- | --- | --- |
| **Hours of Operation hrs/yr** | **Reference** | **Measure code** |
| 4380 | ASTM1484 | F108 |
| 4380 | ASTM1484 | F109 |

### 1.4.5 Time of use Adjustment Factor

The TOU adjustment factor for all non A/C measures is 0.

# Section 2. Calculation Methods

**The UES (Unit Energy Savings) savings are adjusted based on Decision 11-07-030, and comments in Attachment A, which stated “Energy Division believes that operating hours, food production rates and baseline efficiencies contribute to overly optimistic UES calculations and recommend a 30% reduction in UES values”. Therefore the final claimable UES numbers are adjusted down 30% and shown in table below.**

Table 10. Final claimable savings

|  |  |  |
| --- | --- | --- |
| **Performance** | **Estimated savings** | **Claimable savings after 30% reduction** |
| Commercial Steam Cooker (Electric) - Annual kWh savings | **30,156** | **30,156\*0.7=21,109** |
| Commercial Steam Cooker (Electric) - Peak kW savings | **6.201** | **6.201\*0.7=4.341** |
| Commercial Steam Cooker (Gas) - Annual therm savings | **3,707** | **3,707\*0.7=2595** |

## 2.1 Electric Energy Savings Estimation Methodologies

The industry standard for energy use and cooking performance of steamers is ASTM Standard Test Method for thePerformance of Steam Cookers (F1484). Table 11 shows an example of the calculation results for electric steamers under ASTM F1484. To simplify the calculation the preheat time is assumed to be 15 min, since the industry standard preheat time is from 10-20min.

Table 11. Commercial Electric Steam Cooker Cost Effectiveness Example

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy Efficient Model** |
| Number of Pans | 6 | 6 |
| 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) | 36 | 12 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats/Day | 1 | 1 |
| Percentage of Time in Constant Steam Mode  0.90 - | 90 | 0 |
| Pounds of Food Cooked per Day | 100 | 100 |
| ASTM Energy to Food (kWh/lb)a | 0.0308 | 0.0308 |
| Daily Energy Consumption (kWh) | 91.4 | 8.79 |
| Average Demand (kW) | 7.62 | 0.73 |
| Estimated Demand Reduction (kW) | - | 6.89 |
| Actual Demand Reduction with CDF of 0.9 |  | **6.201** |
| Annual Energy Consumption (kWh) | 33,364 | 3,208 |
| Estimated Energy Savings (kWh/yr) | - | **30,156** |
| Annual Water Consumption (gal) | 157,680 | 52,560 |
| Estimated Water Savings (gal) | - | 105,120 |
| Estimated Useful Life (EUL) b | 12 years | 12 years |

a This is the average value calculated by FSTC through ASTM F1484 test through weight and temperature measurement of test product cooked steam cookers (105 Btu/lb for red potato); 105/3412=0.0308 kWh/lb)

[http://www.fishnick.com/publications/appliancereports/steamers/](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.fishnick.com_publications_appliancereports_steamers_&d=CwMFAw&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=GPoBpuGZzY1xg-6yS4ibEc8lU5s2U-yC3jgx_kqZ9B0&s=qOcbG5zKwAHp8uwJrz0dCLwwgx3ZuUwniMMwgkgskjQ&e=)

b The estimated useful life is based on DEER EUL estimates.

**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) |
| EHOU = | Operating Hours/Day |
| PC = | Production Capacity (lbs/hr) |
| TP = | Preheat Time (min) |
| % Steam | Percentage of Time in Constant Steam Mode |
| EP = | Preheat Energy (kWh) |

**Daily Energy Consumption Calculation Example:**

Hand calculation may generate slightly different number due to rounding errors.

## 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.

The demand reduction estimation is based on measured data for standard efficiency electric steamers and for high efficiency steamers that meet EnergyStar requirements (greater than 50% cooking efficiency). The measured data are derived from tests conducted under ASTM Standard Test Method for thePerformance of Steam Cookers (F1484).

ASTM F1484 provides standard conditions under which steamer energy use is measured. The estimated demand reduction of6.89 kilowatts is based on data from tests of standard efficiency and high efficiency steamer cookers. A Coincidence Factor of 0.9 for food service establishments was applied using the professional judgement of the Food Service Technology Center, yielding demand savings of **6.201 kilowatts.**

## 2.3 Gas Energy Savings Estimation Methodologies

The industry standard for energy use and cooking performance of steamers is ASTM Standard Test Method for thePerformance of Steam Cookers (F1484). Table 12 shows an example of the calculation results for gas steamers under ASTM F1484. To simplify the calculation the preheat time is assumed to be 15 min, since the industry standard preheat time is from 10-20min.

Table 12. Commercial Gas Steam Cooker Cost Effectiveness Example

|  |  |  |
| --- | --- | --- |
| **Performance** | **Base Model** | **Energy Efficient Model** |
| Number of Pans | 6 | 6 |
| Preheat Energy (Btu) | 20,000 | 9,000 |
| Idle Energy Rate (Btu/h) | 15,000 | 2,921 |
| Cooking-Energy Efficiency (%) | 15% | 45% |
| Production Capacity (lb/h) | 140 | 125 |
| Average Water Consumption Rate (gal/hr) | 36 | 12 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats/Day | 1 | 1 |
| Percentage of Time in Constant Steam Mode | 90 | 0 |
| Pounds of Food Cooked per Day | 100 | 100 |
| ASTM Energy to Food (Btu/lb)a | 105 | 105 |
| Annual Energy Consumption (therms) b | 3,942 | 235 |
| Estimated Energy Savings (therms/yr) | - | **3,707** |
| Annual Water Consumption (gal) | 157,680 | 52,560 |
| Estimated Water Savings (gal) | - | 105,120 |
| Estimated Useful Life (EUL) c | 12 years | 12 years |

a This is the average value calculated by FSTC through ASTM F1484 test through weight and temperature measurement of test product cooked steam cookers (105 Btu/lb for red potato)

[http://www.fishnick.com/publications/appliancereports/steamers/](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.fishnick.com_publications_appliancereports_steamers_&d=CwMFAw&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=GPoBpuGZzY1xg-6yS4ibEc8lU5s2U-yC3jgx_kqZ9B0&s=qOcbG5zKwAHp8uwJrz0dCLwwgx3ZuUwniMMwgkgskjQ&e=)

b 1 therm = 100,000 Btu.

C The estimated useful life is based on DEER EUL estimates.

**Daily Energy Consumption Calculation and Definitions**

Where:

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

**Daily Energy Consumption Calculation Example:**

Hand calculation may generate slightly different number due to rounding errors.

# Section 3. Load Shapes

Load Shapes are an important part of the life-cycle cost analysis of any energy efficiency program portfolio. The net benefits associated with a measure are based on the amount of energy saved and the avoided cost per unit of energy saved. For electricity, the avoided cost varies hourly over an entire year. Thus, the net benefits calculation for a measure requires both the total annual energy savings (kWh) of the measure and the distribution of that savings over the year. The distribution of savings over the year is represented by the measure’s load shape. The measure’s load shape indicates what fraction of annual energy savings occurs in each time period of the year. An hourly load shape indicates what fraction of annual savings occurs for each hour of the year. A Time-of-Use (TOU) load shape indicates what fraction occurs within five or six broad time-of-use periods, typically defined by a specific utility rate tariff. Formally, a load shape is a set of fractions summing to unity, one fraction for each hour or for each TOU period. Multiplying the measure load shape with the hourly avoided cost stream determines the average avoided cost per kWh for use in the life cycle cost analysis that determines a measure’s Total Resource Cost (TRC) benefit.

## 3.1 Base Case Load Shapes

The base case load shape would be expected to follow a typical non-residential foodservice end use load shape.

Commercial steam cookers 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 commercial steam cookers 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, commercial steam cookers are used to prepare food within a few days to a few hours before it is served, so loads tend to not necessarily be coincident with regular meal periods (breakfast, lunch, and dinner). Between meal periods commercial steam cookers may be used to prepare ingredients for either the next meal period or for menu items to be served the next several days (in which case the ingredients are refrigerated immediately after cooking).

## 3.2 Measure Load Shapes

For purposes of the net benefits estimates in the E3 calculator, what is required is the load shape that ideally represents the *difference* between the base equipment and the installed energy efficiency measure. This *difference* load profile is what is called the Measure Load Shape and would be the preferred load shape for use in the net benefits calculations.

The measure load shape for this measure is determined by the E3 calculator based on the applicable non-residential market sector and the foodservice end-use.

The electric demand profile for the high-efficiency electric commercial steam cookers is expected to be the same as the Base Case. The profile will vary as explained in Section 3.1. The Measure Load Shape for the high-efficiency commercial steam cookers will use less energy and have a lower demand profile.

The gas load profile for the high efficiency gas commercial steam cookers is expected to be the same as the Base Case. The profile will vary as explained in Section 3.1. The Measure Load Shape for the high efficiency commercial steam cookers will use less energy.

# Section 4. Base Case & Measure Costs

High-efficiency commercial steam cookers typically have a higher list price than standard efficiency commercial steam cookers. However, high-efficiency designs are often bundled with other features such as all stainless steel construction and high quality components and controls. In addition to lower operating costs, high-efficiency commercial steam cookers exhibit better uniformity and higher production rates that increase their cost-effectiveness.

Equipment prices for these work papers were compiled from a number of sources including, Autoquotes, equipment sales reps and manufacturer sources[[7]](#endnote-7). Since equipment pricing in food service is closely held information and prices vary widely according to buying volume and other factors, we cannot list the sources for prices specifically.

## 4.1 Base Cases Costs

The Base Case costs include only the equipment. High efficiency commercial steam cookers require no additional labor or maintenance compared to base case commercial steam cookers. Since this measure is applicable for ROB and NEW installations, the installation and maintenance costs are expected to be the same for the customer. The estimated equipment costs for both Base and Measure cases are based on recent list cost data for electric and gas commercial steam cookers and applying an industry-standard 50% discount to the manufacturer published list prices.

## 4.2 Measure Costs

The Measure costs include only the equipment, as explained in Section 4.1. The estimated equipment cost is based on recent list cost data (see Appendix A).

## 4.3 Incremental & Full Measure Costs

Incremental measure costs are used in the analysis.

Table 13. Equipment Incremental Cost Data for Energy Efficient Commercial Steam Cookers

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Baseline Unit Price** | **Energy Efficient Unit Price** | **Incremental Price Difference** | **Baseline Unit Cost** | **Energy Efficient Unit Cost** | **Incremental Measure Cost (IMC)** |
| Electric Steam Cooker | $10,925 | $15,189 | $4,264 | $5,463 | $7,594 | $2,131 |
| Gas Steam Cooker | $17,272 | $23,074 | $5,802 | $8636 | $11,537 | $2,901 |

\*Estimated purchase price and Incremental Measure Cost (IMC) were based on list prices from AutoQuotes catalog in 2010

**Appendix A**

**Equipment Cost Data for Electric Commercial Steam Cookers Updated 2010**

| Designation | Group | List Price ($) | Cost ($)\* |
| --- | --- | --- | --- |
| B1 | Baseline | $7,880 | $3,940 |
| B2 | Baseline | $11,375 | $5,688 |
| B3 | Baseline | $7,618 | $3,809 |
| B4 | Baseline | $10,159 | $5,080 |
| B5 | Baseline | $8,172 | $4,086 |
| B6 | Baseline | $11,309 | $5,655 |
| B7 | Baseline | $9,795 | $4,898 |
| B8 | Baseline | $11,220 | $5,610 |
| B9 | Baseline | $9,095 | $4,548 |
| B10 | Baseline | $13,010 | $6,505 |
| B11 | Baseline | $9,855 | $4,928 |
| B12 | Baseline | $12,990 | $6,495 |
| B13 | Baseline | $14,736 | $7,368 |
| B14 | Baseline | $15,736 | $7,868 |
| EE1 | Energy Efficient | $8,550 | $4,275 |
| EE2 | Energy Efficient | $12,005 | $6,003 |
| EE3 | Energy Efficient | $10,795 | $5,398 |
| EE4 | Energy Efficient | $11,250 | $5,625 |
| EE5 | Energy Efficient | $10,340 | $5,170 |
| EE6 | Energy Efficient | $11,250 | $5,625 |
| EE7 | Energy Efficient | $9,710 | $4,855 |
| EE8 | Energy Efficient | $12,050 | $6,025 |
| EE9 | Energy Efficient | $10,310 | $5,155 |
| EE10 | Energy Efficient | $11,520 | $5,760 |
| EE11 | Energy Efficient | $9,600 | $4,800 |
| EE12 | Energy Efficient | $12,710 | $6,355 |
| EE13 | Energy Efficient | $9,750 | $4,875 |
| EE14 | Energy Efficient | $9,750 | $4,875 |
| EE15 | Energy Efficient | $9,750 | $4,875 |
| EE16 | Energy Efficient | $9,750 | $4,875 |
| EE17 | Energy Efficient | $9,750 | $4,875 |
| EE18 | Energy Efficient | $9,332 | $4,666 |
| EE19 | Energy Efficient | $11,718 | $5,859 |
| EE20 | Energy Efficient | $17,737 | $8,869 |
| EE21 | Energy Efficient | $27,578 | $13,789 |
| EE22 | Energy Efficient | $34,394 | $17,197 |
| EE23 | Energy Efficient | $35,038 | $17,519 |
| EE24 | Energy Efficient | $35,558 | $17,779 |
| EE25 | Energy Efficient | $36,466 | $18,233 |
| EE26 | Energy Efficient | $36,866 | $18,433 |
| EE27 | Energy Efficient | $9,168 | $4,584 |
| EE28 | Energy Efficient | $10,018 | $5,009 |
| EE29 | Energy Efficient | $12,601 | $6,301 |
| EE30 | Energy Efficient | $10,651 | $5,326 |
| EE31 | Energy Efficient | $10,700 | $5,350 |
| EE32 | Energy Efficient | $10,284 | $5,142 |
| EE33 | Energy Efficient | $14,272 | $7,136 |

\*Estimated purchase price and Incremental Measure Cost (IMC) were based on list prices from AutoQuotes catalog in 2010

**Equipment Cost Data for Gas Commercial Steam Cookers Updated 2010**

| Designation | Group | List Price ($) | Cost ($)\* |
| --- | --- | --- | --- |
| B1 | Baseline | $15,309 | $7,655 |
| B2 | Baseline | $15,460 | $7,730 |
| B3 | Baseline | $15,365 | $7,683 |
| B4 | Baseline | $27,000 | $13,500 |
| B5 | Baseline | $15,860 | $7,930 |
| B6 | Baseline | $15,410 | $7,705 |
| B7 | Baseline | $17,594 | $8,797 |
| B8 | Energy Efficient | $16,174 | $8,087 |
| EE1 | Energy Efficient | $14,180 | $7,090 |
| EE2 | Energy Efficient | $28,660 | $14,330 |
| EE3 | Energy Efficient | $18,818 | $9,409 |
| EE4 | Energy Efficient | $25,440 | $12,720 |
| EE5 | Energy Efficient | $28,270 | $14,135 |

\*Estimated purchase price and Incremental Measure Cost (IMC) were based on list prices from AutoQuotes catalog in 2010

# References

1. American Society for Testing and Materials, *Standard Test Method for the Performance of Steam Cookers*; ASTM Designation F1484, in Annual Book of ASTM Standards, West Conshohocken, PA [↑](#endnote-ref-1)
2. 2003 Energy Star® Program Requirements for Commercial Steam Cookers;

   <http://www.energystar.gov/index.cfm?c=steamcookers.pr_crit_steamcookers> [↑](#endnote-ref-2)
3. SupportTable\_NTG.csv, from DEER Database for Energy-Efficient Resources; Version 2016, READI v.2.4.3 (Current Ex Ante data) found at <http://www.deeresources.com/> [↑](#endnote-ref-3)
4. SupportTable\_EUL.csv, from DEER Database for Energy-Efficient Resources; Version 2016, READI v.2.4.3 (Current Ex Ante data) found at <http://www.deeresources.com/>

   [↑](#endnote-ref-4)
5. 2005 California Energy Commission (CEC) Title 20 Appliance Efficiency Regulations, CEC 400-2005-012, p. 69 [↑](#endnote-ref-5)
6. Fisher-Nickel, inc., D. Fisher, et al., Koeller J, Koeller and Company, 2005; *Evaluating the Water Saving Potential of Commercial “Connectionless” Food Steamers*.

   [http://www.fishnick.com/equipment/techassessment/Appliance\_Tech\_Assessment.pdf](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.fishnick.com_equipment_techassessment_Appliance-5FTech-5FAssessment.pdf&d=CwMFAw&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=8GUF8BsIyD7iMSlChzete0XPQTuFl3CsoU_QQ5cvRbU&s=7KXfG9Kd-nc6obo3KT6NpkBzh_0CkQxHbIuq8SZbTVY&e=) [↑](#endnote-ref-6)
7. AutoQuotes electronic catalog for foodservice equipment and supplies <http://www.aqnet.com/> [↑](#endnote-ref-7)