**Work Paper PGECOFST104**

**Commercial Steam Cooker**

**Revision # 5**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Commercial Steam Cooker-Electric and Gas**

**Measure Codes F108, F109**

# At-a-Glance Summary

|  |  |  |
| --- | --- | --- |
| **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 kWh/yr | Source: PG&E Calculations 3,707 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 $11537 |
| **Gross Measure Cost ($/unit)** | Source: PG&E Calculations $7594 | Source: PG&E Calculations $11537 |
| **Measure Incremental Cost ($/unit):** | Source: PG&E Calculations $2132 | Source: PG&E Calculations $2901 |
| **Effective Useful Life (years):** | 12 years -- Source: [www.Deeresources.com](http://www.Deeresources.com) EUL | 12 years -- Source: [www.Deeresources.com](http://www.Deeresources.com) EUL |
| **Measure Application Type:** | Replace on Burnout (ROB), and New Construction (NC). | Replace on Burnout (ROB), and New Construction (NC). |
| **Net-to-Gross Ratios:** | Source: DEER 2014 COM>2yrs= 0.6 | Source: DEER 2014 COM>2yrs= 0.6 |
| **Important Comments:** |  |  |

# Work Paper Approvals

The following Manager(s) approved this workpaper through the PG&E Electronic Data Routing System under Routing Requisition # \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
|  |
| **Grant Brohard**  Manager, Technical Product Support |
| **Carolyn Weiner**  Manager, Appliance Products |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Revision Date** | **Section-by-Section Description of Revisions** | **Author (Company)** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Revision 0 | | 12/11/2007 | Original work paper: Commercial Steam Cooker PGECOFST104 R0.doc | | David Zabrowski (Fisher-Nickel, inc.) | |
| Revision 1 | | 6/1/09 | 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) |

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# 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.

***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. ENERGY STAR® maintains an updated list of qualifying products and specifications at www.energystar.gov. Consult with the manufacturer or manufacturer’s representative to determine if a non-ENERGY STAR® qualified model meets the efficiency requirements in Table 1.

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 The rebate is available to all customers throughout the PG&E territory and other statewide IOU’s as well. It is open to all building types and vintages. The measure is offered on a Replace on Burnout or New Construction, as nearly all equipment is only replaced when it is no longer working.

## 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 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.

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 DEER Measure Cost Data Users Guide, version 2.01[[3]](#endnote-3), defines the terms as follows:

* Early Retirement (ER) – replacing a working technology prior to failure. *Previously known as RET.*
* Replace on Burnout (ROB) – replacing a technology at the end of its useful life.
* New Construction (NC) – installing a technology in a new construction or major renovation project.

Since there are no EM&V studies on the useful life of steamers 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.

The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2014Database Format* hyperlink, DEER2014, spreadsheet *SPTdata\_format-V0.97.xls*, defines the terms as follows:

Table 2 Measure Application Type[[4]](#endnote-4)

*Identifies the measure application type in the Measure Implemenation table in DEER2014*

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ER | Early retirement | *Measure is more efficient than code/std; Dual baseline, full measure costs required* |
| ROB | Replace on Burnout | *Single baseline (above code), incremental or full costs* |
| NC | New Construction | *Single baseline (above code), incremental or full costs* |
| REA | Retrofit Add On | *Single baseline (above pre-existing), full measure costs required* |

## 1.4 Product Base Case and Measure Case Data

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 3.

**Table 3 ASTM test results for Baseline Commercial Steam Cookers.**

|  |  |
| --- | --- |
| **Steamer Type** | **Cooking-Energy Efficiency\*** |
| Electric Steamers | 26% |
| Gas Steamers | 38% |

\*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 as of April 20, 2012. The complete list is in Appendix A and the averages are summarized in Table 4.

**Table 4 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.

## 1.4.1 DEER Base Case and Measure Case Information

The DEER2014 database does not contain information on energy use or savings or equipment costs for an energy efficient electric or gas steam cooker measure. The only reference in DEER2014 is for Effective Useful Life (EUL). DEER data was used for the DEER Use and Technology Table.

**Table 5 DEER Use and Technology Table.**



**Hours of Operation**: DEER 2014 does not include hours of operation for this measure type. Work papers were 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.

**Base Case Costs and Measure Case Costs:** DEER2014 does not contain cost data for Electric or Gas Steam Cookers.

**Net-to-Gross Assumption:** The DEER2014 database does not specifically list food service appliances, therefore the default for commercial measures offered more than 2 years is used. 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 6 below summarizes all applicable DEER based Net-to-Gross ratios for programs that may be used by this measure.

Table 6 DEER Net-to-Gross Ratios

|  |  |
| --- | --- |
|  |  |
| Program Approach | NTG |
| Com Default > 2yrs | 0.6 |

**Effective Useful Life / Remaining Useful Life:**

The DEER2014 database shows a EUL of 12 years and an RUL of 4 years6 for all cooking appliance measures, including electric and gas steam cookers.

**Effective Useful Life: DEER Version and Impact IDs**

* The Effective Useful Life estimates were downloaded directly from DEER, they match the intended measures for climate zones and building types and vintages.

**Table 7 DEER2014 Effective Useful Life**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Building type** | **Bldg Vintage** | **Climate Zone** | **EUL (yrs)** | **RUL (yrs)** | **DEER Version** |
| **ANY** | **ANY** | **ALL** | **12** | **4** | **DEER2014** |

## 

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

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

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.

## 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

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[[5]](#endnote-5) documenting the real world differences in energy and water consumption differences between boiler-based and boilerless 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 in Table 8.

**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**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Building type** | **Bldg Vintage** | **Climate Zone** | **Hours of Operation hrs/yr** | **Reference** | **Measure code** |
| **ANY** | **ANY** | **ANY** | **4380** | **ASTM1484** | **F108** |
| **ANY** | **ANY** | **ANY** | **4380** | **ASTM1484** | **F109** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

**Base Case Costs and Measure Case Costs:**

Building variations were averaged across all quick serve and full serve restaurant types throughout California.

**Table 10 Base Case and Measure Case Costs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Costs ($)** | | |  |
| **Building type** | **Bldg Vintage** | **Climate Zone** | **Base Case** | **Measure Case** | **IMC** | **Reference** |
| **ANY** | **ANY** | **ANY** | **$5463** | **$7594** | **$2132** | **F108** |
| **ANY** | **ANY** | **ANY** | **$8636** | **$11537** | **$2901** | **F109** |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

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

DEER2014 database shows a EUL of 12 years and an RUL of 4 years6 for all cooking appliance measures, including electric and gas steam cookers.

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

**In-service rate/first year installation rate**: ISR is assumed to be 1 based on engineering expertise.

***1.4.5 Time-of-Use Adjustment Factor***

We are required by CPUC decision 06-06-063 dated June 29, 2006 to apply time-of-use (TOU) adjustment factors on residential A/C and commercial A/C (packaged and split-system direct-expansion cooling) measures only. Since this is not an A/C measure, the TOU adjustment factor is 0.

The specific values and results are summarized in 11.

Table 11 TOU Adjustment Factors

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure** | ***kWAC*** | ***kWTotal*** | **%** |
| Food Service | 0 | 0 | 0 |

***1.5 Summary of Inputs for Savings Calculations***

The following table provides references to sections that document the inputs for calculation:

**Table 12 Summary of Inputs for Savings Calculations**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Input Variable** | **Variations** | **Base Case 1 Average Value** | **Base Case 2 Average Value** | **Measure Case Average Value** | **Reference Section** |
| **Electric Savings F108** | None | N/A | *N/A* | *30,156 kWh/yr* | *Section 2.1* |
| **Gas Savings F109** | None | N/A | N/A | 3,707 Th/yr | Section 2.3 |
| **Hours of operation** | None | 4380 | N/A | 4380 | Section 1.4.1 |
| **Full Cost Electric F108** | None | $5463 | N/A | *$7594* | Section 1.4.4 |
| **Full Cost Gas F109** |  | $8636 | N/A | $11537 | Section1.4.4 |
| **Incremental Cost Electric F108** | None |  | N/A | $2132 |  |
| **Incremental Cost Gas F109** | None |  | N/A | $2901 |  |
| **EUL /RUL** | None | 12 | N/A | 12 | Section 1.4.1 |
| **NTG** | None | 0.6 | N/A | 0.6 | Section 1.1.1 |
| **ISR** | No | 1 | N/A | 1 | Section 1.4,4 |
| **TOU Factor** | *A/C projects only* | *N/A* | *N/A* | *N/A* | *Section 1.4.5* |

# Section 2. Calculation Methods

Table13 Baseline by Measure Application Type

|  |  |  |  |
| --- | --- | --- | --- |
| ****Measure Application Type**** | ****Measure Life Basis**** | ****First Baseline Period: Energy Savings Baseline**** | ****Second Baseline Period: Energy Savings Baseline**** |
| ***ER* (early retirement)** | **EUL** | Customer Average Baseline | Code Baseline |
| ***ROB* (replace-on-burnout)** | **EUL** | Code Baseline | N/A |
| ***NC* (new construction)** | **RUL/EUL-RUL** | Code Baseline | N/A |

Notes:

* For ROB measures, First Baseline is the baseline for the full EUL. There is no second baseline.
* For ER measures, First Baseline Period is the period for the RUL(remaining useful life),defined by the CPUC as RUL=1/3 EUL. Second baseline period for ER is Code baseline for the period EUL-RUL.

## 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 14 shows an example of the calculation results for electric steamers under ASTM F1484.

**Table 14 Commercial Electric Steam Cooker Cost Effectiveness Example.**

|  |  |  |
| --- | --- | --- |
| **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 | $5.00 |
| ASTM Energy to Food (kWh/lb) | 0.0308 | 0.0308 |
| Percentage of Time in Constant Steam Mode | 0.90 | - |
| Daily Energy Consumption (kWh) | 91.4 | 8.8 |
| Average Demand (kW) | 7.6 | 0.7 |
| Estimated Demand Reduction (kW) | - | 6.9 |
| Annual Energy Consumption (kWh) | 33,364 | 3,208 |
| Estimated Energy Savings (kWh/yr) | - | 30,156 |
| Annual Water Consumption (gal) | 175,200 | 8,760 |
| Estimated Water Savings (gal) | - | 166,440 |
| Annual Energy Cost ($) | $4,337 | $417 |
| Estimated Cost Savings ($/yr) | - | $3,920 |
| Annual Water Cost ($/yr) a | $1,171 | $59 |
| Estimated Water Cost Savings ($/yr) a | - | $1,113 |
| Incremental Measure Cost b | - | SEE APPENDIX A |
| Estimated Useful Life (EUL) c | 12 years | 12 years |

a Water and wastewater cost are based on a rate of $2.00/CCF water and $3.00/CCF wastewater.

(1 CCF = 748 gallons)

b Incremental measure cost was determined through communications with local manufacturers and distributors to determine the retail cost to purchase a qualifying model over the baseline standard.

c The estimated useful life is based on the 2011 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) |
| 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.

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 of 6.9 kilowatts is based on data from tests of standard efficiency and high efficiency steamer cookers. Applying a Coincidence Factor of 0.9 per the DEER methodology[[6]](#endnote-6), yields a Demand Savings of 6.2 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 14 shows an example of the calculation results for gas steamers under ASTM F1484.

Table 15 Commercial Gas Steam Cooker Cost Effectiveness Example.

|  |  |  |
| --- | --- | --- |
| **Performance** | **Base Model** | **Energy Efficient Model** |
| Pan Capacity | 6 | 6 |
| Preheat Time (min) | 15 | 15 |
| 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) | 40 | 4 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Pounds of Food Cooked per Day | 100 | 100 |
| Gas Cost ($/therm) | $1.00 | $1.00 |
| Water/Sewer Cost ($/CCF) | $5.00 | $5.00 |
| ASTM Energy to Food (Btu/lb) | 105 | 105 |
| Percentage of Time in Constant Steam Mode | 0.90 | - |
| Daily Energy Consumption (Btu) | 1,079,904 | 64,318 |
| Annual Energy Consumption (therms) a | 3,942 | 235 |
| Estimated Energy Savings (therms/yr) | - | 3,707 |
| Annual Water Consumption (gal) | 175,200 | 17,520 |
| Estimated Water Savings (gal) | - | 157,680 |
| Annual Energy Cost ($) | 3,942 | $235 |
| Estimated Energy Cost Savings ($/yr) | - | $3,707 |
| Annual Water Cost ($/yr)b | $1,171 | $117 |
| Estimated Water Cost Savings ($/yr) b | - | $1,054 |
| Incremental Measure Cost c | - | SEE APPENDIX A |
| Estimated Useful Life (EUL) d | 12 years | 12 years |

a 1 therm = 100,000 Btu.

b Water and wastewater cost are based on a rate of $2.00/CCF water and $3.00/CCF wastewater.

(1 CCF = 748 gallons)

c Incremental measure cost was determined through comparison of an average of published pricing listed in APPENDIX A.

d The estimated useful life is based on the 2011 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) |
| TON = | Operating Hours/Day |
| PC = | Production Capacity (lbs/hr) |
| TP = | Preheat Time (min) |
| % Steam = | Percentage of Time in Constant Steam Mode |
| EP = | Preheat Energy (Btu) |

# *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 closest load shape chosen for this measure is the DEER:Indoor\_Non-CFL\_Ltg load shape. See Table 8 for a list of all Building Types and Load Shapes. See the KEMA report [31] for a more thorough discussion regarding the load shapes for this measure.

Table 16 Base Case Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **E3 Alt. Building Type** | **Load Shape** |
| Restaurant – Fast Food | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Office – Small | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |

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

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.

## 3.2 Measure Load Shapes

There are no measure case load shapes applicable to this(ese) measure(s). The base case shapes are to be used in the cost avoidance calculation. 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 nonresidential market sector and the foodservice end-use.

The electric demand profile for the high efficiency electric steamer 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 steamer will use less energy and have a lower demand profile.

The gas load profile for the high-efficiency gas steamer 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 steamer will use less energy.

Table17 Measure Case Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **E3 Alt. Building Type** | **Load Shape** |
| Restaurant – Fast Food | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Office – Small | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |

# 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.

**Table 18 Base Case & Measure Case DEER Definitions**

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period Full Measure Cost (RUL)** | **Second Baseline Period Full Measure Cost (EUL – RUL)** |
| ***NC (new construction)*** | EUL | Calculated as Incremental Measure Cost | N/A |
| ***ROB(replace on burnout)*** | EUL | Calculated as Incremental Measure Cost | N/A |
| ***ER (early retirement)*** | RUL/  EUL-RUL | Calculated as Full Gross Measure Cost | Calculated as Negative Full Gross Base Case Cost |

## 

## 4.1 Base Case(s) Costs

The following Measure Application Types are appropriate to this measure. The Base Case Costs are:

**Table 19 Base Case Costs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Base Case Cost** |
| F108 | NC / ROB | Industry Practice | $5463 | $N/A | $N/A | $5463 |
| *F109* | NC / ROB | *Industry Practice* | *$8636* | *$N/A* | *$N/A* | *`$8636* |

*All costs are noted as $ per measure unit*

The Base Case costs include only the equipment. High efficiency steamers require no additional labor or maintenance compared to base case steamers. Since this measure is applicable for ROB and NC installations, the installation and maintenance costs are expected to be the same for the customer. The estimated equipment cost is based on recent list cost data for electric and gas steamers and applying an industry-standard 50% discount to the manufacturer published list prices. 10-12

Equipment prices for these work papers were compiled from a number of sources including, Autoquotes, equipment sales reps and manufacturer sources. 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.

## 4.2 Measure Case Costs

The following Measure Application Types are appropriate to these measures. The Measure Case Costs are:

**Table 20 Measure Case Costs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Measure Case Cost** |
| F108 | ROB/NC | Industry Practice | $7594 | N/A | N/A | $7594 |
| *F109* | ROB/NC | *Industry Practice* | *$11537* | *N/A* | *N/A* | *$11537* |

*All costs are noted as $ per measure unit*

The Measure costs include only the equipment, as explained in Section 4.1. The estimated equipment cost is based on recent list cost data and applying an industry-standard 50% discount to the manufacturer published list prices (see Appendix B)[[7]](#endnote-7).

## 4.3 Incremental & Full Measure Costs

Incremental costs are used in this analysis.

# *4.3.1 Full Measure Cost*

Full Measure Cost is the cost to install an energy efficient measure per the CPUC calculators. This definition implies a different meaning depending on the Measure Application type.

This Measure Application Types are: **NC** or **ROB**, so the Full Measure Cost (FMC) is represented by the equation below:

FMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: We assume that, unless stated otherwise, the measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

FMC = Measure Equipment Cost – Base Case Equipment *Cost*

*FMC = $ 7594 per (unit) - $ 5463 per (unit) = $ 2132 per unit for Electric Steam Cookers F108*

**OR**

*FMC = $ 11537per (unit) - $ 8636 per (unit) = $2901 per unit for Gas Steam Cookers F109*

\*Note: Various complicated price fluctuations are not addressed in these equations, such as future costs due to inflation in labor, future costs due to deflation in material cost, and other variables that cannot be accurately described at this time.

# *4.3.2 Incremental Measure Costs*

Incremental Measure Cost is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure. While IMC has a straightforward definition depending on the Measure Application type, the equation does vary.

This Measure Application Types are: **ROB,** or **NC** so the Gross Measure Cost (GMC) is represented by the appropriate equation below:

IMC = Measure Equipment Cost – Base Case Equipment Cost

*MC = $ 7594 per (unit) - $ 5463 per (unit) = $ 2132 per unit for Electric Steam Cookers F108*

**OR**

*FMC = $ 11537per (unit) - $ 8636 per (unit) = $2901 per unit for Gas Steam Cookers F109*

**Table 21 Summary Table for Section 4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Measure ID** | **Measure Application Types** | **Base Case Total Cost** | **Measure Case Total Cost[[8]](#endnote-8)** | **Full Measure Case Cost** | **Incremental Measure Cost** |
| **F108** | ROB/NC | **$5463** | **$7594** | **$7594** | **$2132** |
| **F109** | ROB/NC | **$8636** | **$11537** | **$11537** | **$2901** |

# 

# Appendix

**Equipment Cost Data for Electric Steam Cookers**

| **Group** | **Make** | **Model** | **List Price ($)** | **Cost ($)\*** |
| --- | --- | --- | --- | --- |
| Baseline | Blodgett | SN-3E | $7,880 | $3,940 |
| Baseline | Blodgett | SN-5E | $11,375 | $5,688 |
| Baseline | Market Forge | PS-3E | $7,618 | $3,809 |
| Baseline | Market Forge | PS-6E | $10,159 | $5,080 |
| Baseline | Market Forge | ST-3E | $8,172 | $4,086 |
| Baseline | Market Forge | ST-6E | $11,309 | $5,655 |
| Baseline | Solaris | SX-3 | $9,795 | $4,898 |
| Baseline | Solaris | SX-5 | $11,220 | $5,610 |
| Baseline | Groen | HY-3E | $9,095 | $4,548 |
| Baseline | Groen | HY-5E | $13,010 | $6,505 |
| Baseline | Groen | SSB-3E | $9,855 | $4,928 |
| Baseline | Groen | SSB-5E | $12,990 | $6,495 |
| Baseline | Vulcan | C24EA5-BSC | $14,736 | $7,368 |
| Baseline | Vulcan | C24EA5-DLX | $15,736 | $7,868 |
| Energy Efficient | AccuTemp | S32083D120 | $8,550 | $4,275 |
| Energy Efficient | AccuTemp | S62083D100 | $12,005 | $6,003 |
| Energy Efficient | AccuTemp | S62083D120 | $10,795 | $5,398 |
| Energy Efficient | AccuTemp | S62083D170 | $11,250 | $5,625 |
| Energy Efficient | AccuTemp | E62081D060 | $10,340 | $5,170 |
| Energy Efficient | AccuTemp | E62083D150 | $11,250 | $5,625 |
| Energy Efficient | Blodgett | SBF-3E | $9,710 | $4,855 |
| Energy Efficient | Blodgett | SBF-5E | $12,050 | $6,025 |
| Energy Efficient | Cleveland Range | 1SCEMCS | $10,310 | $5,155 |
| Energy Efficient | Cleveland Range | 1SCE | $11,520 | $5,760 |
| Energy Efficient | Cleveland Range | 22CET3.1 | $9,600 | $4,800 |
| Energy Efficient | Cleveland Range | 22CET6.1 | $12,710 | $6,355 |
| Energy Efficient | Intek | XS-208-6-1 | $9,750 | $4,875 |
| Energy Efficient | Intek | XS-208-14-3 | $9,750 | $4,875 |
| Energy Efficient | Intek | XS-208-12-3 | $9,750 | $4,875 |
| Energy Efficient | Intek | XS-208-8-3 | $9,750 | $4,875 |
| Energy Efficient | Intek | XS-208-8-1 | $9,750 | $4,875 |
| Energy Efficient | Market Forge | ET-3E | $9,332 | $4,666 |
| Energy Efficient | Market Forge | ET-6E | $11,718 | $5,859 |
| Energy Efficient | Market Forge | ETP-5E | $17,737 | $8,869 |
| Energy Efficient | Market Forge | ETP-10E | $27,578 | $13,789 |
| Energy Efficient | Market Forge | ST-10M42E24A | $34,394 | $17,197 |
| Energy Efficient | Market Forge | ST-10M42E32A | $35,038 | $17,519 |
| Energy Efficient | Market Forge | ST-10M42E36A | $35,558 | $17,779 |
| Energy Efficient | Market Forge | ST-10M42E42A | $36,466 | $18,233 |
| Energy Efficient | Market Forge | ST-10M42E48A | $36,866 | $18,433 |
| Energy Efficient | Solaris | EPX-3 | $9,168 | $4,584 |
| Energy Efficient | Solaris | EPX-5 | $10,018 | $5,009 |
| Energy Efficient | Stellar | Altair-6 | $12,601 | $6,301 |
| Energy Efficient | Stellar | Capella-6 | $10,651 | $5,326 |
| Energy Efficient | Groen | VRC-6E | $10,700 | $5,350 |
| Energy Efficient | Vulcan | VPX3 | $10,284 | $5,142 |
| Energy Efficient | Vulcan | VPX5 | $14,272 | $7,136 |

\*Estimated purchase price and Incremental Measure Cost (IMC) were based on an industry-standard 50% discount off the manufacturer’s list price.

**Equipment Cost Data for Gas Steam Cookers**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Make** | **Model** | **List Price ($)** | **Cost($)\*** |
| Baseline | Market Forge | ST-5G | $15,309 | $7,655 |
| Baseline | Cleveland | 21CGA5 | $15,460 | $7,730 |
| Baseline | Groen | HY-5 | $15,365 | $7,683 |
| Baseline | Groen | SSB-10GF | $27,000 | $13,500 |
| Baseline | Groen | SSB-5G | $15,860 | $7,930 |
| Baseline | Blodget Steam | SN-5G | $15,410 | $7,705 |
| Baseline | Solaris | SX-5G | $17,594 | $8,797 |
| Baseline | Southbend | SX-5G | $16,174 | $8,087 |
| Energy Efficient | Intek | XSG-5 | $14,180 | $7,090 |
| Energy Efficient | Market Forge | ETP-10G | $28,660 | $14,330 |
| Energy Efficient | Market Forge | ETP-5G | $18,818 | $9,409 |
| Energy Efficient | Cleveland | 24CGA6.2SES | $25,440 | $12,720 |
| Energy Efficient | Cleveland | 24CGA10.2ES | $28,270 | $14,135 |

\*Estimated purchase price and Incremental Measure Cost (IMC) were based on an industry-standard 50% discount off the manufacturer’s list price.

**Equipment Incremental Cost Data for Energy Efficient Steam Cookers\***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Category** | **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 | $2,132 |
| 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 an industry-standard 50% discount off the manufacturer’s list price.

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