**Work Paper PGECOFST100**

#### Commercial Combination Oven

**Revision # 6**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Commercial Combination Ovens/Steamer-Electric and Gas**

Measure Codes F100, F101, HA16, HA19, HA48, HA49

# At a Glance Summary-Electric Combination Ovens/Steamers

|  |  |  |  |
| --- | --- | --- | --- |
| **Applicable Measure Codes:** | **HA16** | **F100** | **HA19** |
| **Measure Description:** | Commercial Combination Ovens/Steamers < 15 pan capacity (Electric) | Commercial Combination Ovens/Steamers 15-28 pan capacity (Electric) | Commercial Combination Ovens/Stemaers > 28 pan capacity (Electric) |
| **Energy Impact Common Units:** | Per unit/Each | Per unit/Each | Per unit/Each |
| **Base Case Description:** | Source: PG&E Calculations Existing Electric Combination Oven | Source: PG&E Calculations Existing Electric Combination Oven | Source: PG&E Calculations Existing Electric Combination Oven |
| **Base Case Energy Consumption:** | Source: PG&E Calculations 30,874 kWh/yr | Source: PG&E Calculations 39,353 kWh/yr | Source: PG&E Calculations 60,606 kWh/yr |
| **Measure Energy Consumption:** | Source: PG&E Calculations 19,373 kWh/yr | Source: PG&E Calculations 24,258 kWh/yr | Source: PG&E Calculations 38,561 kWh/yr |
| **Energy Savings (Base Case – Measure)** | Source: PG&E Calculations 11,501 kWh/yr | Source: PG&E Calculations 15,095 kWh/yr | Source: PG&E Calculations 22,045 kWh/yr |
| **Costs Common Units:** | Per unit/Each | Per unit/Each | Per unit/Each |
| **Base Case Equipment Cost ($/unit):** | Source: PG&E Calculations $9,137 | Source: PG&E Calculations $15,024 | Source: PG&E Calculations $19,610 |
| **Measure Equipment Cost ($/unit):** | Source: PG&E Calculations $10,705 | Source: PG&E Calculations $16,608 | Source: PG&E Calculations $26,658 |
| **Measure Incremental Cost ($/unit):** | Source: PG&E Calculations $1,568 | Source: PG&E Calculations $1,584 | Source: PG&E Calculations $7,048 |
| **Effective Useful Life (years):** | EULID =  Cook-ElecCombOven  12 years –  Source: 2016 DEER | EULID =  Cook-ElecCombOven  12 years –  Source: 2016 DEER | EULID =  Cook-ElecCombOven  12 years –  Source: 2016 DEER |
| **Program Type:** | Replace on Burnout (ROB), and New Construction (NC). | Replace on Burnout (ROB), and New Construction (NC). | Replace on Burnout (ROB), and New Construction (NC). |
| **Net-to-Gross Ratios:** | Source: 2016 DEER  NTGID= Com-Default>2yrs | Source: 2016 DEER Com- NTGID= Default>2yrs | Source: 2016 DEER Com- NTGID= Default>2yrs |
| **Important Comments:** |  |  |  |

# At a Glance Summary – Gas Combination Ovens/Steamers

|  |  |  |  |
| --- | --- | --- | --- |
| **Applicable Measure Codes:** | **HA48** | **F101** | **HA49** |
| **Measure Description:** | Commercial Combination Ovens/Steamers < 15 pan capacity (Gas) | Commercial Combination Ovens/Steamers 15-28 pan capacity (Gas) | Commercial Combination Ovens/Steamers > 28 pan capacity (Gas) |
| **Energy Impact Common Units:** | Per unit/Each | Per unit/Each | Per unit/Each |
| **Base Case Description:** | Source: PG&E Calculations Existing Gas Combination Oven | Source: PG&E Calculations Existing Gas Combination Oven | Source: PG&E Calculations Existing Gas Combination Oven |
| **Base Case Energy Consumption:** | Source: PG&E Calculations 1,572 Therms/yr | Source: PG&E Calculations 2,087 Therms/yr | Source: PG&E Calculations 3,134 Therms/yr |
| **Measure Energy Consumption:** | Source: PG&E Calculations 774 Therms/yr | Source: PG&E Calculations 967 Therms/yr | Source: PG&E Calculations 1,561 Therms/yr |
| **Energy Savings (Base Case – Measure)** | Source: PG&E Calculations 798 Therms/yr | Source: PG&E Calculations 1,120 Therms/yr | Source: PG&E Calculations 1,573 Therms/yr |
| **Costs Common Units:** | Per unit/Each | Per unit/Each | Per unit/Each |
| **Base Case Equipment Cost ($/unit):** | Source: PG&E Calculations $11,157 | Source: PG&E Calculations $16,807 | Source: PG&E Calculations $22,730 |
| **Measure Equipment Cost ($/unit):** | Source: PG&E Calculations $14,746 | Source: PG&E Calculations $20,168 | Source: PG&E Calculations $30,620 |
| **Measure Incremental Cost ($/unit):** | Source: PG&E Calculations $3,589 | Source: PG&E Calculations $3,361 | Source: PG&E Calculations $7,890 |
| **Effective Useful Life (years):** | EULID =  Cook-GasCombOVen  12 years --  Source: 2016 DEER | EULID =  Cook-GasCombOVen  12 years --  Source: 2016 DEER | EULID =  Cook-GasCombOVen  12 years --  Source: 2016 DEER |
| **Program Type:** | Replace on Burnout (ROB), and New Construction (NC). | Replace on Burnout (ROB), and New Construction (NC). | Replace on Burnout (ROB), and New Construction (NC). |
| **Net-to-Gross Ratios:** | Source: 2016 DEER  NTGID= Com-Default>2yrs | Source: 2016 DEER  NTGID= Com-Default>2yrs | Source: 2016 DEER  NTGID= Com-Default>2yrs |
| **Important Comments:** |  |  |  |

# Document Revision History

**Revision # Date Description Author (Company)**

|  |  |  |  |
| --- | --- | --- | --- |
| Revision 0 | 12/11/2007 | Original work paper -- Commercial Combination Ovens PGECOFST100 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 | 2/10/2010 | Update to DEER 2009-11 NTG file | David Zabrowski (Fisher-Nickel, inc.), Steve Blanc PG&E |
| Revision 3 | 7/15/2010 | Update language for NTG and EUL per ED comments | Charlene Spoor (PG&E) |
| Revision 4 | 5/31/2012  8/22/2012 | Updated NTG, EUL, IMC, and savings analysis  Broke down savings for different sizes for SCG/SCE  Updated BLD, CZ and VIN to ANY per READI requirements | David Zabrowski (Fisher-Nickel, inc.)  Charlene Spoor (PG&E) |
| Revision 5 | 3/13/14 | Updated format for July 1, 2014 submittal. Updated measure codes as needed. | Charlene Spoor CLCi (PG&E) |
| Revision 6 | 5/24/2016 | Updated the format for 1/1/2016 | Denis Livchak (Fisher-Nickel, inc.)  Reviewer: Alina Zohrabian (PG&E) |
| Revision 6 | 8/5/2016 | Updated calc tables to match online calculator ; updated formulas and incorporated examples | Alina Zohrabian (PG&E)  Mini Damodaran (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 Combination Oven/steamer (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 –***

**HA16, F100, and HA19:** The electric combination oven/steamer must have a tested steam mode cooking energy efficiency of ≥50% and convection mode cooking energy efficiency of ≥70% utilizing American Society for Testing and Materials (ASTM) Standard F2861[[1]](#endnote-1) and meet the idle rate requirements.

**HA48, F101, and HA49:** The gas combination oven/steamer must have a tested steam mode cooking energy efficiency of ≥38% and convection mode cooking energy efficiency of ≥44% utilizing American Society for Testing and Materials (ASTM) Standard F2861, and meet the idle rate requirements.

**SCE 1, SCE 2, SCG 1, 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 electric or gas combination ovens/steamers that meet the qualifications. 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.

F100 and F101: This rebate 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- Idle Rate Requirements for Commercial Combination Oven/Steamers.

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Code** | **Combi Oven Type** | **Steam Mode  Idle Energy Rate** | **Convection Mode  Idle Energy Rate** |
| HA16 | Electric Combi <15 pan capacity\* | ≤ 5.0 kW | ≤ 2.0 kW |
| F100 | Electric Combi 15−28 pan capacity\* | ≤ 6.0 kW | ≤ 2.5 kW |
| HA19 | Electric Combi >28 pan capacity\* | ≤ 9.0 kW | ≤ 4.0 kW |
| HA48 | Gas Combi < 15 pan capacity\* | ≤ 15,000 Btu/h | ≤ 8,000 Btu/h |
| F101 | Gas Combi 15−28 pan capacity\* | ≤ 18,000 Btu/h | ≤ 10,000 Btu/h |
| HA49 | Gas Combi > 28 pan capacity\* | ≤ 28,000 Btu/h | ≤ 16,000 Btu/h |

\*Combination oven/steamer pan capacity is based on the maximum capacity of full-size 2 ½-inch deep hotel pans. This must be consistent with the number of pans used to meet the energy-efficiency qualifications per ASTM F2861.

***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

An oven can be simply described as a fully enclosed, insulated chamber used to heat food. Commercial combination ovens offer even more options with their ability to add steam to the oven cavity. In addition to baking and roasting, a combination oven is also capable of steaming, proofing and reheating various food products. Foods can be cooked in a convection oven dry heat only mode, a steam only mode, and a combination of dry heat and steam modes. The programmability of combination ovens also allows food to be cooked partially in one mode at a certain temperature, and then finished in another mode and at a separate temperature. For example, a turkey can be cooked in combination mode at low temperature for several hours, and then stepped to a higher temperature in dry heat mode to finish. With competition rising among equipment manufacturers, new designs that incorporate timesaving features via sophisticated control packages are being introduced.

Combination ovens are available in a variety of sizes ranging from 6-pan countertop models to 40-pan roll-in models. Combination oven sizes are based on the capacity to accommodate 12 x 20 x 21/2-inch hotel pans. Half-size models can accommodate one column of hotel pans and 9 x 13-inch (half-size) sheet pans, while full-size models can accommodate two columns of hotel pans and 18 x 26-inch (full-size) sheet pans.

Oven performance is determined by applying the ASTM Standard Test Method for the Performance of Combination Ovens in Various Modes (F2861). The ASTM standard test method is considered to be the industry standard for quantifying the energy consumption, efficiency and cooking performance of combination ovens.

## 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 combination ovens 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 combination oven 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 and found in section 4.

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

DEER NTGR Values file does not specifically list commercial food service appliances The default used for non-residential measures is 0.6[[2]](#endnote-2).

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

Table 3- DEER 2016 Net-to-Gross Ratios

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

**Effective Useful Lives**

DEER database shows a EUL of 12 years and an RUL of 4 years[[3]](#endnote-3) for all cooking appliance measures, including electric and gas combination ovens.

Table 4- DEER Effective Useful Life

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Code** | **EUL (yrs)** | **RUL (yrs)** | **DEER Version** | **EULID** |
| HA16/F100/HA19 | 12 | N/A | DEER2016 | Cook-ElecCombOven |
| HA48/F101/HA49 | 12 | N/A | DEER2016 | Cook-GasCombOVen |

**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[[4]](#endnote-4) has a category for cooking appliances, but combination ovens are not included.

#### California Title 24

There are no State of California Title 24 Efficiency Regulation requirements for combination ovens.

#### Federal

#### There are no Federal energy efficiency requirements for Combination Ovens.

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

Prior to 2010, the ASTM Standard Test Method for the Performance of Combination Ovens (F1639-05)[[5]](#endnote-5) was the benchmark for quantifying estimated energy use and cooking performance of combination ovens and was used to estimate the energy consumption of the base case and measure equipment.

Subsequent testing found that the cooking-energy efficiency test in F1639-05 may not be the most representative of combination oven energy usage. Furthermore, it was determined that the method could provide inconsistent results when comparing one model to another as it was originally based on first generation combination oven models, which have changed considerably since the last revision to the test method. The new test method for the enhanced performance of combination ovens in different operation modes examines the cooking performance in convection and steam modes, using a testing methodology that has been well established in the ASTM test methods for steam cookers (F1484)[[6]](#endnote-6) and convection ovens (F1496)[[7]](#endnote-7), while adapting the methodology to work specifically for combination ovens. This method was ratified by ASTM in 2010 as F2861-10. With F2861 effectively replacing the outdated F1639 for evaluating commercial combination ovens, ASTM plans to withdraw F1639 from active status in 2012.

In 2011, ASTM F2861-10 was used to estimate the energy consumption of 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 in 2002, which included a chapter on ovens[[8]](#endnote-8). The study showed that standard electric oven efficiency varies from 50 to 80% and standard gas oven efficiency varies from 30% to 40%, based on oven type (convection, combination, conventional, etc.). For the standard steam mode the cooking-energy efficiency came from average of gas boiler atmospheric (13%) and gas boiler pressure (27%). The efficiency range can be seen in table 7-1 on page 7-20 and Figure 8-6 on page 8-9 of <http://www.fishnick.com/equipment/techassessment/Appliance_Tech_Assessment.pdf>

Title 20 regulations do not include a minimum performance requirement for combi ovens, the base case for existing models of electric and gas combination ovens was determined as the average value for the convection efficiency range from table 7-1 for Standard Gas and Electric Combination Ovens.

This Work Paper uses ASTM Standard Test Method for thePerformance of Combination Ovens in Various Modes (F2861) 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 combination ovens, 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[[9]](#endnote-9).

Table 6- Baseline ASTM Test Results for Commercial Combination Ovens/Steamers.

|  |  |  |  |
| --- | --- | --- | --- |
| **Combination Oven Type** | **Idle Energy Rate** | **Cooking-Energy Efficiency\*** | **Production Capacity\*** |
| Electric Combi < 15 pan capacity\* | 3,000 W oven mode 10,000 W steam mode | 65% oven mode 40% steam mode | 80 lb/h oven mode 100 lb/h steam mode |
| Electric Combi 15−28 pan capacity\* | 3,750 W oven mode 12,500 W steam mode | 65% oven mode 40% steam mode | 100 lb/h oven mode 150 lb/h steam mode |
| Electric Combi > 28 pan capacity\* | 5,250 W oven mode 18,000 W steam mode | 65% oven mode 40% steam mode | 275 lb/h oven mode 350 lb/h steam mode |
| Gas Combi < 15 pan capacity\* | 15,000 Btu/h oven mode 45,000 Btu/h steam mode | 35% oven mode 20% steam mode | 80 lb/h oven mode 100 lb/h steam mode |
| Gas Combi 15−28 pan capacity\* | 20,000 Btu/h oven mode 60,000 Btu/h steam mode | 35% oven mode 20% steam mode | 100 lb/h oven mode 150 lb/h steam mode |
| Gas Combi > 28 pan capacity\* | 30,000 Btu/h oven mode 80,000 Btu/h steam mode | 35% oven mode 20% steam mode | 275 lb/h oven mode 350 lb/h steam mode |

\*Based on the ASTM F2861.

The measure case data was drawn from data generated by The PG&E Food Service Technology Center in San Ramon, the Southern California Gas Company Foodservice Equipment Center in Downey and the Southern California Edison Foodservice Technology Center in Irwindale. The lab-based test data was used to establish a measure case level that effectively differentiated between standard-efficiency models and energy-efficient models. The performance parameters used to determine the energy consumption for the measure case is summarized below.

Table 7- Measure Case ASTM Test Results for Commercial Combination Ovens/Steamers

|  |  |  |  |
| --- | --- | --- | --- |
| **Combination Oven Type** | **Idle Energy Rate** | **Cooking-Energy Efficiency\*** | **Production Capacity\*** |
| Electric Combi < 15 pan capacity\* | 2,000 W oven mode 5,000 W steam mode | 70% oven mode 50% steam mode | 100 lb/h oven mode 120 lb/h steam mode |
| Electric Combi 15−28 pan capacity\* | 2,500 W oven mode 6,000 W steam mode | 70% oven mode 50% steam mode | 125 lb/h oven mode 200 lb/h steam mode |
| Electric Combi > 28 pan capacity\* | 4,000 W oven mode 9,000 W steam mode | 70% oven mode 50% steam mode | 325 lb/h oven mode 400 lb/h steam mode |
| Gas Combi < 15 pan capacity\* | 8,000 Btu/h oven mode 15,000 Btu/h steam mode | 44% oven mode 38% steam mode | 100 lb/h oven mode 120 lb/h steam mode |
| Gas Combi 15−28 pan capacity\* | 10,000 Btu/h oven mode 18,000 Btu/h steam mode | 44% oven mode 38% steam mode | 125 lb/h oven mode 200 lb/h steam mode |
| Gas Combi > 28 pan capacity\* | 16,000 Btu/h oven mode 28,000 Btu/h steam mode | 44% oven mode 38% steam mode | 325 lb/h oven mode 400 lb/h steam mode |

\*Based on the ASTM F2861.

### 1.4.5 Time of use Adjustment Factor

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

# Section 2. Calculation Methods

## 2.1 Electric Energy Savings Estimation Methodologies

The industry standard for energy use and cooking performance of combination ovens is ASTM Standard Test Method for thePerformance of Combination ovens (F2861). Tables 8-10 show examples of the calculation results for electric combination ovens based on data obtained from applying the ASTM F2861 test method. To simplify the calculation the preheat time is assumed to be 15 min, since the industry standard preheat time is from 10-20min.

Table 8- Commercial 12-Pan Electric Combination Oven/Steamer Cost Effectiveness Example[[10]](#endnote-10)

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy-Efficient Model** |
| Number of Steam Pans | 12 | 12 |
| Preheat Energy (kWh) | 3.00 | 1.50 |
| Convection Idle Energy Rate (kW) | 3.00 | 2.00 |
| Convection Cooking Energy Efficiency (%) | 65% | 70% |
| Convection Production Capacity (lbs/hr) | 80 | 100 |
| Steam Idle Energy Rate (kW) | 10.00 | 5.00 |
| Steam Cooking Energy Efficiency (%) | 40% | 50% |
| Steam Production Capacity (lbs/hr) | 100 | 120 |
| Average Water Consumption Rate (gal/h) | 42 | 18 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats per Day | 1 | 1 |
| Percentage Time in Steam Mode | 50% | 50% |
| Pounds of Food Cooked per Day | 200 | 200 |
| Estimated Useful Life (EUL)a | 12 years | 12 years |
| ASTM Convection Mode Energy to Food (kWh/lb)b | 0.0732 | 0.0732 |
| ASTM Steam Mode Energy to Food (kWh/lb)c | 0.0308 | 0.0308 |
| Daily Energy Consumption (kWh) | 84.6 | 53.1 |
| Average Demand (kW) | 7.0 | 4.4 |
| Estimated Demand Reduction (kW) | - | 2.6 |
| Actual Demand Reduction with a CDF of 0.9 (kW) |  | **2.34** |
| Annual Energy Consumption (kWh) | 30,874 | 19,373 |
| Estimated Energy Savings (kWh/yr) | - | **11,501** |
| Annual Water Consumption (gal) | 91,980 | 39,420 |
| Estimated Water Savings (gal) | - | 52,560 |

a The estimated useful life is based on DEER EUL estimates

b This is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato); 250/3412=0.0732 kWh/lb)

[http://www.fishnick.com/publications/appliancereports/convectionovens/](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.fishnick.com_publications_appliancereports_convectionovens_&d=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=xiQt0BJefxi1OOdFkKZw68uwF1ADiFrzRTcIJvZNzVQ&s=k--GDCdnQ_T7bin0pEeeBnubYisig4zpIhizmi6w_b0&e=)

c. 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=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=xiQt0BJefxi1OOdFkKZw68uwF1ADiFrzRTcIJvZNzVQ&s=FjRiJgZ1xUwaj6TV7n4bZBSxzkm0Sf791Kn98AYzlgE&e=)

Table 9- Commercial 20-Pan Electric Combination Oven/Steamer Cost Effectiveness Example[[11]](#endnote-11)

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy-Efficient Model** |
| Number of Steam Pans | 20 | 20 |
| Preheat Energy (kWh) | 3.75 | 2.00 |
| Convection Idle Energy Rate (kW) | 3.75 | 2.50 |
| Convection Cooking Energy Efficiency (%) | 65% | 70% |
| Convection Production Capacity (lbs/hr) | 100 | 125 |
| Steam Idle Energy Rate (kW) | 12.50 | 6.00 |
| Steam Cooking Energy Efficiency (%) | 40% | 50% |
| Steam Production Capacity (lbs/hr) | 150 | 200 |
| Average Water Consumption Rate (gal/h) | 70 | 30 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats per Day | 1 | 1 |
| Percentage Time in Steam Mode | 50% | 50% |
| Pounds of Food Cooked per Day | 250 | 250 |
| Estimated Useful Life (EUL) a | 12 years | 12 years |
| ASTM Convection Mode Energy to Food (kWh/lb)b | 0.0732 | 0.0732 |
| ASTM Steam Mode Energy to Food (kWh/lb)c | 0.0308 | 0.0308 |
| Daily Energy Consumption (kWh) | 107.8 | 66.5 |
| Average Demand (kW) | 9.0 | 5.5 |
| Estimated Demand Reduction (kW) | - | 3.5 |
| Actual Demand Reduction with a CDF of 0.9 (kW) |  | **3.15** |
| Annual Energy Consumption (kWh) | 39,353 | 24,258 |
| Estimated Energy Savings (kWh/yr) | - | **15,095** |
| Annual Water Consumption (gal) | 153,300 | 65,700 |
| Estimated Water Savings (gal) | - | 87,600 |

a The estimated useful life is based on DEER EUL estimates

b This is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato); 250/3412=0.0732 kWh/lb)

[http://www.fishnick.com/publications/appliancereports/convectionovens/](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.fishnick.com_publications_appliancereports_convectionovens_&d=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=xiQt0BJefxi1OOdFkKZw68uwF1ADiFrzRTcIJvZNzVQ&s=k--GDCdnQ_T7bin0pEeeBnubYisig4zpIhizmi6w_b0&e=)

c 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=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=xiQt0BJefxi1OOdFkKZw68uwF1ADiFrzRTcIJvZNzVQ&s=FjRiJgZ1xUwaj6TV7n4bZBSxzkm0Sf791Kn98AYzlgE&e=)

Table 10- Commercial 40-Pan Electric Combination Oven/Steamer Cost Effectiveness Example[[12]](#endnote-12)

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy-Efficient Model** |
| Number of Steam Pans | 40 | 40 |
| Preheat Energy (kWh) | 5.63 | 3.00 |
| Convection Idle Energy Rate (kW) | 5.25 | 4.00 |
| Convection Cooking Energy Efficiency (%) | 65% | 70% |
| Convection Production Capacity (lbs/hr) | 275 | 325 |
| Steam Idle Energy Rate (kW) | 18.00 | 9.00 |
| Steam Cooking Energy Efficiency (%) | 40% | 50% |
| Steam Production Capacity (lbs/hr) | 350 | 400 |
| Average Water Consumption Rate (gal/h) | 140 | 60 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats per Day | 1 | 1 |
| Percentage Time in Steam Mode | 50% | 50% |
| Pounds of Food Cooked per Day | 400 | 400 |
| Estimated Useful Life (EUL) a | 12 years | 12 years |
| ASTM Convection Mode Energy to Food (kWh/lb)b | 0.0732 | 0.0732 |
| ASTM Steam Mode Energy to Food (kWh/lb)c | 0.0308 | 0.0308 |
| Daily Energy Consumption (kWh) | 166.0 | 105.6 |
| Average Demand (kW) | 13.8 | 8.8 |
| Estimated Demand Reduction (kW) | - | 5.0 |
| Actual Demand Reduction with a CDF of 0.9 (kW) |  | **4.5** |
| Annual Energy Consumption (kWh) | 60,606 | 38,561 |
| Estimated Energy Savings (kWh/yr) | - | **22,045** |
| Annual Water Consumption (gal) | 306,600 | 131,400 |
| Estimated Water Savings (gal) | - | 175,200 |

a The estimated useful life is based on DEER EUL estimates

b This is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato); 250/3412=0.0732 kWh/lb)

[http://www.fishnick.com/publications/appliancereports/convectionovens/](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.fishnick.com_publications_appliancereports_convectionovens_&d=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=xiQt0BJefxi1OOdFkKZw68uwF1ADiFrzRTcIJvZNzVQ&s=k--GDCdnQ_T7bin0pEeeBnubYisig4zpIhizmi6w_b0&e=)

c 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=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=xiQt0BJefxi1OOdFkKZw68uwF1ADiFrzRTcIJvZNzVQ&s=FjRiJgZ1xUwaj6TV7n4bZBSxzkm0Sf791Kn98AYzlgE&e=)

**Daily Energy Consumption Calculation and Definitions**

Where:

|  |  |
| --- | --- |
| EDAY = | Calculated Daily Energy Consumption (kWh/day) |
| LBFOOD = | Estimated Pounds of Food Cooked per Day |
| EFOOD = | ASTM Energy to Food (kWh/lb) = kWh/pound of energy absorbed by food product during cooking based on the ASTM test method |
| EFFICIENCY = | Measured Heavy Load Cooking Energy Efficiency % |
| IDLE RATE = | Measured Idle Energy Rate (kW) |
| EHOU = | Estimated Operating Hours/Day |
| PC = | Measured Production Capacity (lbs/hr) |
| TP = | Estimated Preheat Time (min) |
| nP = | Estimated Number of preheats/Day |
| EP =  PTS= | Measured Preheat Energy (kWh)  Percentage time in steam mode |

**Daily Energy Consumption Example:**

Hand calculation may generate slightly different number due to rounding to significant digits.

## 2.2. Demand Reduction Estimation Methodologies

A combination oven’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 combination ovens and for high-efficiency combination ovens. The measured data are derived from tests conducted under ASTM Standard Test Method for thePerformance of Combination ovens (F2861).

ASTM F2861 provides standard conditions under which combination oven energy use is measured. The estimated demand reduction of 2.6 kW for models with less than 15 pan capacity, 3.5 kW for models with a pan capacity between 15 and 28 pans and 5.0 kW for models with a capacity greater than 28 pans is based on data from tests of standard efficiency and high efficiency electric combination ovens. Applying a Coincidence Factor of 0.9 for food service establishments using the professional judgement of the Food Service Technology Center yields a Demand Savings of 2.34 kW for models with less than 15 pan capacity, 3.15 kW models with a pan capacity between 15 and 28 pans and 4.5 kW for models with a capacity greater than 28 pans.

## 2.3. Gas Energy Savings Estimation Methodologies

The industry standard for energy use and cooking performance of combination ovens is ASTM Standard Test Method for thePerformance of Combination Ovens (F2861). Table 11-13 shows an example of the calculation results under ASTM F2861. 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 12-Pan Gas Combination Oven/Steamer Cost Effectiveness Example.[[13]](#endnote-13)

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy-Efficient Model** |
| Number of Steam Pans | 12 | 12 |
| Preheat Energy (Btu) | 18,000 | 13,000 |
| Convection Idle Energy Rate (Btu/h) | 15,000 | 8,000 |
| Convection Heavy Load Cooking Energy Efficiency (%) | 35% | 44% |
| Convection Production Capacity (lbs/hr) | 80 | 100 |
| Steam Idle Energy Rate (Btu/h) | 45,000 | 15,000 |
| Steam Cooking Energy Efficiency (%) | 20% | 38% |
| Steam Production Capacity (lbs/hr) | 100 | 120 |
| Average Water Consumption Rate (gal/h) | 42 | 18 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats per Day | 1 | 1 |
| Percentage Time in Steam Mode | 50% | 50% |
| Pounds of Food Cooked per Day | 200 | 200 |
| ASTM Convection Mode Energy to Food (Btu/lb) a | 250 | 250 |
| ASTM Steam Mode Energy to Food (Btu/lb)b | 105 | 105 |
| Annual Energy Consumption (therms) c | 1,572 | 774 |
| Estimated Energy Savings (therms/yr) | - | **798** |
| Average Energy Consumption Rate (Btu/h) | 35,890 | 17,673 |
| Daily Energy Consumption (Btu) | 430,680 | 212,076 |
| Annual Water Consumption (gal) | 91,980 | 39,420 |
| Estimated Water Savings (gal) | - | 52,560 |
| Estimated Useful Life (EUL) d | 12 years | 12 years |

a This is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato)

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b 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)

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c 1 therm = 100,000 Btu.

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

Table 12- Commercial 20-Pan Gas Combination Oven/Steamer Cost Effectiveness Example.[[14]](#endnote-14)

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy-Efficient Model** |
| Number of Steam Pans | 20 | 20 |
| Preheat Energy (Btu) | 22,000 | 16,000 |
| Convection Idle Energy Rate (Btu/h) | 20,000 | 10,000 |
| Convection Heavy Load Cooking Energy Efficiency (%) | 35% | 44% |
| Convection Production Capacity (lbs/hr) | 100 | 125 |
| Steam Idle Energy Rate (Btu/h) | 60,000 | 18,000 |
| Steam Cooking Energy Efficiency (%) | 20% | 38% |
| Steam Production Capacity (lbs/hr) | 150 | 200 |
| Average Water Consumption Rate (gal/h) | 70 | 30 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats per Day | 1 | 1 |
| Percentage Time in Steam Mode | 50% | 50% |
| Pounds of Food Cooked per Day | 250 | 250 |
| ASTM Convection Mode Energy to Food (Btu/lb) a | 250 | 250 |
| ASTM Steam Mode Energy to Food (Btu/lb)b | 105 | 105 |
| Annual Energy Consumption (therms) c | 2,087 | 967 |
| Estimated Energy Savings (therms/yr) | - | **1,120** |
| Average Energy Consumption Rate (Btu/h) | 47,659 | 22,068 |
| Daily Energy Consumption (Btu) | 571,908 | 264,816 |
| Annual Water Consumption (gal) | 153,300 | 65,700 |
| Estimated Water Savings (gal) | - | 87,600 |
| Estimated Useful Life (EUL) d | 12 years | 12 years |

a This is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato)

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b 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)

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c 1 therm = 100,000 Btu.

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

Table 13- Commercial 40-Pan Gas Combination Oven/Steamer Cost Effectiveness Example.[[15]](#endnote-15)

|  |  |  |
| --- | --- | --- |
| **Performance** | **Baseline Model** | **Energy-Efficient Model** |
| Number of Steam Pans | 40 | 40 |
| Preheat Energy (Btu) | 32,000 | 24,000 |
| Convection Idle Energy Rate (Btu/h) | 30,000 | 16,000 |
| Convection Heavy Load Cooking Energy Efficiency (%) | 35% | 44% |
| Convection Production Capacity (lbs/hr) | 275 | 325 |
| Steam Idle Energy Rate (Btu/h) | 80,000 | 28,000 |
| Steam Cooking Energy Efficiency (%) | 20% | 38% |
| Steam Production Capacity (lbs/hr) | 350 | 400 |
| Average Water Consumption Rate (gal/h) | 140 | 60 |
| Operating Hours/Day | 12 | 12 |
| Operating Days/Year | 365 | 365 |
| Number of Preheats per Day | 1 | 1 |
| Percentage Time in Steam Mode | 50% | 50% |
| Pounds of Food Cooked per Day | 400 | 400 |
| ASTM Convection Mode Energy to Food (Btu/lb) a | 250 | 250 |
| ASTM Steam Mode Energy to Food (Btu/lb)b | 105 | 105 |
| Annual Energy Consumption (therms) c | 3,134 | 1,561 |
| Estimated Energy Savings (therms/yr) | - | **1,573** |
| Average Energy Consumption Rate (Btu/h) | 71,548 | 35,629 |
| Daily Energy Consumption (Btu) | 858,576 | 427,548 |
| Annual Water Consumption (gal) | 306,600 | 131,400 |
| Estimated Water Savings (gal) | - | 175,200 |
| Estimated Useful Life (EUL) d | 12 years | 12 years |

a This is the average value calculated by FSTC through ASTM F1496 test through weight and temperature measurement of test product cooked in convection ovens (250 Btu/lb for russet potato)

[http://www.fishnick.com/publications/appliancereports/convectionovens/](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.fishnick.com_publications_appliancereports_convectionovens_&d=CwMFAg&c=hLS_V_MyRCwXDjNCFvC1XhVzdhW2dOtrP9xQj43rEYI&r=TlrXy5TrK8nTfd5c4pv-ow&m=xiQt0BJefxi1OOdFkKZw68uwF1ADiFrzRTcIJvZNzVQ&s=k--GDCdnQ_T7bin0pEeeBnubYisig4zpIhizmi6w_b0&e=)

b 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)

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c 1 therm = 100,000 Btu.

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

***Daily Energy Consumption Calculation and Definitions***

Where:

EDAY = Calculated Daily Energy Consumption (Btu/day)

LBFOOD = Estimated Pounds of Food Cooked per Day

EFOOD = ASTM Energy to Food (Btu/lb) = Btu/pound of energy absorbed by food product during cooking

EFFICIENCY= Measured Heavy Load Cooking Energy Efficiency %

IDLE RATE= Measured Idle Energy Rate (Btu/h)

EHOU= Estimated Operating Hours/Day

PC = Measured Production Capacity (lbs/hr)

TP = Estimated Preheat Time (min)

nP = Estimated Number of preheats/Day

EP = Measured Preheat Energy (Btu)

PTS= Percentage time in steam mode

**Daily Energy Consumption Example:**

Hand calculation may generate slightly different number due to rounding to significant digits.

# 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 combination oven 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 combination ovens 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, combination ovens 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 combination ovens 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 combination oven 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 combination oven will use less energy and have a lower demand profile.

The gas load profile for the high efficiency gas combination oven 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 combination oven will use less energy.

# Section 4. Base Case & Measure Costs

High-efficiency combination ovens typically have a higher list price than standard efficiency combination ovens. 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 combination ovens 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[[16]](#endnote-16). 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 combination ovens require no additional labor or maintenance compared to base case combination ovens. 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 combination ovens 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 14- Equipment Incremental Cost Data for Energy Efficient Combination Ovens/Steamers Updated 2012\*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Combination Oven Type** | **Designation Code** | **Baseline Unit Price** | **Energy Efficient Unit Price** | **Incremental Price Difference** | **Baseline Unit Cost** | **Energy Efficient Unit Cost** | **Incremental Measure Cost (IMC)** |
| Electric Combi < 15 pan capacity\* | HA16 | $18,274 | $21,411 | $3,137 | $9,137 | $10,705 | $1,568 |
| Electric Combi 15−28 pan capacity\* | F100 | $30,048 | $33,216 | $3,168 | $15,024 | $16,608 | $1,584 |
| Electric Combi > 28 pan capacity\* | HA19 | $39,220 | $53,316 | $14,096 | $19,610 | $26,658 | $7,048 |
| Gas Combi < 15 pan capacity\* | HA48 | $22,315 | $29,491 | $7,177 | $11,157 | $14,746 | $3,588 |
| Gas Combi 15−28 pan capacity\* | F101 | $33,613 | $40,336 | $6,723 | $16,807 | $20,168 | $3,361 |
| Gas Combi > 28 pan capacity\* | HA49 | $45,460 | $61,240 | $15,780 | $22,730 | $30,620 | $7,890 |

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

Appendix A

**Equipment Cost Data for Electric Combination Ovens/Steamers Updated 2012**

| **Oven** | **Group** | **Hotel Pan Capacity** | **List Price ($)** | **Cost ($)\*** |
| --- | --- | --- | --- | --- |
| **B1** | **Baseline** | 6 | $18,200 | $9,100 |
| **B2** | **Baseline** | 20 | $35,984 | $17,992 |
| **B3** | **Baseline** | 6 | $20,720 | $10,360 |
| **B4** | **Baseline** | 10 | $24,900 | $12,450 |
| **B5** | **Baseline** | 20 | $30,000 | $15,000 |
| **B6** | **Baseline** | 20 | $33,000 | $16,500 |
| **B7** | **Baseline** | 6 | $21,000 | $10,500 |
| **B8** | **Baseline** | 20 | $33,200 | $16,600 |
| **B9** | **Baseline** | 10 | $19,950 | $9,975 |
| **B10** | **Baseline** | 6 | $15,200 | $7,600 |
| **B11** | **Baseline** | 6 | $17,708 | $8,854 |
| **B12** | **Baseline** | 20 | $27,240 | $13,620 |
| **B13** | **Baseline** | 20 | $33,447 | $16,724 |
| **B14** | **Baseline** | 10 | $14,130 | $7,065 |
| **B15** | **Baseline** | 20 | $19,610 | $9,805 |
| **B16** | **Baseline** | 20 | $27,900 | $13,950 |
| **B17** | **Baseline** | 40 | $39,220 | $19,610 |
| **B18** | **Baseline** | 6 | $9,450 | $4,725 |
| **B19** | **Baseline** | 12 | $15,090 | $7,545 |
| **B20** | **Baseline** | 10 | $24,382 | $12,191 |
| **B21** | **Baseline** | 6 | $17,992 | $8,996 |
| **EE1** | **Energy Efficient** | 20 | $28,660 | $14,330 |
| **EE2** | **Energy Efficient** | 40 | $42,750 | $21,375 |
| **EE3** | **Energy Efficient** | 14 | $17,063 | $8,532 |
| **EE4** | **Energy Efficient** | 20 | $32,400 | $16,200 |
| **EE5** | **Energy Efficient** | 24 | $41,890 | $20,945 |
| **EE6** | **Energy Efficient** | 40 | $62,830 | $31,415 |
| **EE7** | **Energy Efficient** | 10 | $25,170 | $12,585 |
| **EE8** | **Energy Efficient** | 20 | $31,480 | $15,740 |
| **EE9** | **Energy Efficient** | 24 | $40,630 | $20,315 |
| **EE10** | **Energy Efficient** | 40 | $60,230 | $30,115 |
| **EE11** | **Energy Efficient** | 14 | $25,480 | $12,740 |
| **EE12** | **Energy Efficient** | 5 | $16,025 | $8,013 |
| **EE13** | **Energy Efficient** | 20 | $26,990 | $13,495 |
| **EE14** | **Energy Efficient** | 40 | $54,638 | $27,319 |
| **EE15** | **Energy Efficient** | 20 | $41,244 | $20,622 |
| **EE16** | **Energy Efficient** | 6 | $17,930 | $8,965 |
| **EE17** | **Energy Efficient** | 20 | $22,790 | $11,395 |
| **EE18** | **Energy Efficient** | 20 | $32,860 | $16,430 |
| **EE19** | **Energy Efficient** | 40 | $46,130 | $23,065 |

\*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 Combination Ovens/Steamers Updated 2012**

| **Oven** | **Group** | **Hotel Pan Capacity** | **List Price ($)** | **Cost ($)\*** |
| --- | --- | --- | --- | --- |
| **B1** | **Baseline** | 20 | $41,400 | $20,700 |
| **B2** | **Baseline** | 6 | $19,450 | $9,725 |
| **B3** | **Baseline** | 10 | $31,480 | $15,740 |
| **B4** | **Baseline** | 20 | $33,729 | $16,865 |
| **B5** | **Baseline** | 14 | $32,068 | $16,034 |
| **B6** | **Baseline** | 20 | $33,102 | $16,551 |
| **B7** | **Baseline** | 20 | $39,309 | $19,655 |
| **B8** | **Baseline** | 10 | $17,530 | $8,765 |
| **B9** | **Baseline** | 20 | $23,970 | $11,985 |
| **B10** | **Baseline** | 20 | $30,170 | $15,085 |
| **B11** | **Baseline** | 40 | $45,460 | $22,730 |
| **B12** | **Baseline** | 6 | $13,530 | $6,765 |
| **B13** | **Baseline** | 12 | $19,830 | $9,915 |
| **EE1** | **Energy Efficient** | 18 | $34,722 | $17,361 |
| **EE2** | **Energy Efficient** | 18 | $34,398 | $17,199 |
| **EE3** | **Energy Efficient** | 40 | $51,131 | $25,566 |
| **EE4** | **Energy Efficient** | 14 | $24,644 | $12,322 |
| **EE5** | **Energy Efficient** | 20 | $40,180 | $20,090 |
| **EE6** | **Energy Efficient** | 24 | $54,520 | $27,260 |
| **EE7** | **Energy Efficient** | 40 | $70,770 | $35,385 |
| **EE8** | **Energy Efficient** | 14 | $32,130 | $16,065 |
| **EE9** | **Energy Efficient** | 20 | $40,120 | $20,060 |
| **EE10** | **Energy Efficient** | 24 | $54,150 | $27,075 |
| **EE11** | **Energy Efficient** | 40 | $70,020 | $35,010 |
| **EE12** | **Energy Efficient** | 14 | $31,700 | $15,850 |
| **EE13** | **Energy Efficient** | 6 | $21,058 | $10,529 |
| **EE14** | **Energy Efficient** | 10 | $27,354 | $13,677 |
| **EE15** | **Energy Efficient** | 20 | $28,450 | $14,225 |
| **EE16** | **Energy Efficient** | 20 | $36,150 | $18,075 |
| **EE17** | **Energy Efficient** | 40 | $53,040 | $26,520 |

\*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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