### 4.2.3 Commercial Steam Cooker

###### Description

To qualify for this measure the installed equipment must be an ENERGY STAR® steamer in place of a standard steamer in a commercial kitchen. Savings are presented dependent on the pan capacity and corresponding idle rate at heavy load cooking capacity and if the steamer is gas or electric.

This measure was developed to be applicable to the following program types: TOS. If applied to other program types, the measure savings should be verified.

**Definition of Efficient Equipment**

To qualify for this measure the installed equipment must be as follows:

|  |  |
| --- | --- |
| **Gas** | **Electric** |
| ENERGY STAR® qualified with 38% minimum cooking energy efficiency at heavy load (potato) cooking capacity for gas steam cookers. | ENERGY STAR® qualified with 50% minimum cooking energy efficiency at heavy load (potato) cooking capacity for electric steam cookers. |

**Definition of Baseline Equipment**

The baseline condition is assumed to be a non-ENERGY STAR® commercial steamer at end of life. It is assumed that the efficient equipment and baseline equipment have the same number of pans.

**Deemed Lifetime of Efficient Equipment**

The expected measure life is assumed to be 12 years[[1]](#footnote-1)

**Deemed Measure Cost**

The incremental capital cost for this measure is $998[[2]](#footnote-2) for a natural gas steam cooker or $2490[[3]](#footnote-3) for an electric steam cooker.

**Loadshape**

Loadshape C01 - Commercial Electric Cooking

**Coincidence Factor**

Summer Peak Coincidence Factor for measure is provided below for different building type[[4]](#footnote-4):

| **Location** | **CF**  **CF** |
| --- | --- |
| Fast Food Limited Menu | 0.32 |
| Fast Food Expanded Menu | 0.41 |
| Pizza | 0.46 |
| Full Service Limited Menu | 0.51 |
| Full Service Expanded Menu | 0.36 |
| Cafeteria | 0.36 |
| Unknown | 0.40 |

**Algorithm**

**Calculation of Savings**

Formulas below are applicable to both gas and electric steam cookers. Please use appropriate lookup values and identified flags.

**Energy Savings**

ΔSavings = (ΔIdle Energy + ΔPreheat Energy + ΔCooking Energy) \* Z

For a gas cooker: ΔSavings = ΔBtu \* 1/100,000 \* Z

For an electric steam cooker: ΔSavings = ΔkWh \*Z

Where:

Z = days/yr steamer operating (use 365.25 days/yr if heavy use restaurant and exact number unknown)

ΔIdle Energy = ((((1- CSM%Baseline)\* IDLEBASE + CSM%Baseline \* PCBASE \* EFOOD / EFFBASE) \* (HOURSday - (F / PCBase) - ( PREnumber \*0.25))) - (((1- CSM%ENERGYSTAR) \* IDLEENERGYSTAR + CSM%ENERGYSTAR \* PCENERGY \* EFOOD / EFFENERGYSTAR) \* (HOURSDay - (F l/ PCENERGY ) - (PREnumber \* 0.25 ))))

Where:

CSM%Baseline = Baseline Steamer Time in Manual Steam Mode (% of time)

= 90%[[5]](#footnote-5)

IDLEBase = Idle Energy Rate of Base Steamer[[6]](#footnote-6)

| **Number of Pans** | **IDLEBASE - Gas, Btu/hr** | **IDLEBASE - Electric, kw** |
| --- | --- | --- |
| 3 | 11,000 | 1.0 |
| 4 | 14,667 | 1.33 |
| 5 | 18,333 | 1.67 |
| 6 | 22,000 | 2.0 |

PCBase = Production Capacity of Base Steamer[[7]](#footnote-7)

| **Number of Pans** | **PCBASE, gas (lbs/hr)** | **PCBASE, electric (lbs/hr)** |
| --- | --- | --- |
| 3 | 65 | 70 |
| 4 | 87 | 93 |
| 5 | 108 | 117 |
| 6 | 130 | 140 |

EFOOD= Amount of Energy Absorbed by the food during cooking known as ASTM Energy to Food (Btu/lb or kW/lb)

=105 Btu/lb[[8]](#footnote-8) (gas steamers) or 0.03088 (electric steamers)

EFFBASE =Heavy Load Cooking Efficiency for Base Steamer

=15%[[9]](#footnote-9) (gas steamers) or 26%9 (electric steamers)

HOURSday  = Average Daily Operation (hours)

| **Type of Food Service** | **Hoursday[[10]](#footnote-10)** |
| --- | --- |
| Fast Food, limited menu | 4 |
| Fast Food, expanded menu | 5 |
| Pizza | 8 |
| Full Service, limited menu | 8 |
| Full Service, expanded menu | 7 |
| Cafeteria | 6 |
| Unknown | 6[[11]](#footnote-11) |
| Custom | Varies |

F = Food cooked per day (lbs/day)

= custom or if unknown, use 100 lbs/day[[12]](#footnote-12)

CSM%ENERGYSTAR = ENERGY STAR Steamer's Time in Manual Steam Mode (% of time)[[13]](#footnote-13)

= 0%

IDLEENERGYSTAR = Idle Energy Rate of ENERGY STAR®[[14]](#footnote-14)

|  |  |  |
| --- | --- | --- |
| **Number of Pans** | **IDLEENERGY STAR – gas, (Btu/hr)** | **IDLEENERGY STAR – electric, (kW)** |
| 3 | 6250 | 0.40 |
| 4 | 8333 | 0.53 |
| 5 | 10417 | 0.67 |
| 6 | 12500 | 0.80 |

PCENERGY = Production Capacity of ENERGY STAR® Steamer[[15]](#footnote-15)

|  |  |  |
| --- | --- | --- |
| **Number of Pans** | **PCENERGY - gas(lbs/hr)** | **PCENERGY – electric (lbs/hr)** |
| 3 | 55 | 50 |
| 4 | 73 | 67 |
| 5 | 92 | 83 |
| 6 | 110 | 100 |

EFFENERGYSTAR = Heavy Load Cooking Efficiency for ENERGY STAR® Steamer(%)

=38%[[16]](#footnote-16) (gas steamer) or 50%15 (electric steamer)

PREnumber = Number of preheats per day

=1[[17]](#footnote-17) (if unknown, use 1)

ΔPreheat Energy = ( PREnumber \* Δ Preheat)

Where:

PREnumber = Number of Preheats per Day

=1[[18]](#footnote-18)(if unknown, use 1)

PREheat = Preheat energy savings per preheat

= 11,000 Btu/preheat[[19]](#footnote-19) (gas steamer) or 0.5 kWh/preheat[[20]](#footnote-20) (electric steamer)

ΔCooking Energy = ((1/ EFFBASE) - (1/ EFFENERGY STAR®)) \* F \* EFOOD

Where:

EFFBASE =Heavy Load Cooking Efficiency for Base Steamer

=15%[[21]](#footnote-21) (gas steamer) or 26%28 (electric steamer)

EFFENERGYSTAR =Heavy Load Cooking Efficiency for ENERGY STAR® Steamer

=38%[[22]](#footnote-22) (gas steamer) or 50%23 (electric steamer)

F = Food cooked per day (lbs/day)

= custom or if unknown, use 100 lbs/day[[23]](#footnote-23)

EFOOD = Amount of Energy Absorbed by the food during cooking known as ASTM Energy to Food[[24]](#footnote-24)

|  |  |
| --- | --- |
| **EFOOD  - gas(Btu/lb)** | **EFOOD (kWh/lb)** |
| 105[[25]](#footnote-25) | 0.0308[[26]](#footnote-26) |

EXAMPLE

For a gas steam cooker: A 3 pan steamer in a full service restaurant

ΔSavings = (ΔIdle Energy + ΔPreheat Energy + ΔCooking Energy) \* Z \* 1/100.000

ΔIdle Energy = ((((1- 0.9)\* 11000 + 0.9 \* 65 \* 105 /0.15 )\*(7 - (100 / 65)-(1\*0.25))) - (((1-0) \* 6250 + 0 \* 55 \* 105 / 0.38) \* (7 - (100 / 55) - (1\*0.25))))

= 188,321

ΔPreheat Energy = (1 \*11,000)

= 11,000

ΔCooking Energy = (((1/ 0.15) - (1/ 0.38)) \* (100 lb/day \* 105 btu/lb)))

= 42368

ΔTherms = (188321 + 11000 + 42368) \* 365.25 \*1/100,000

= 883 therms

For an electric steam cooker: A 3 pan steamer in a cafeteria:

ΔSavings = (ΔIdle Energy + ΔPreheat Energy + ΔCooking Energy) \* Z

ΔIdle Energy = ((((1- .9)\* 1.0 + .9 \* 70 \* 0.0308 /0.26 )\*(6 - (100 / 70)-(1\*.25))) - (((1-0) \* 0.4 + 0 \* 50 \* 0.0308 / 0.50) \* (6 - (100 / 50) - (1\*0.25))))

= 31.18

ΔPreheat Energy = (1 \*0.5))

= 0.5

ΔCooking Energy = (((1/ 0.26) - (1/ 0.5)) \* (100 \* 0.0308)))

= 5.69

ΔkWh = (31.18 + 0.5 + 5.69) \* 365.25 days

= 13,649 kWh

**Summer Coincident Peak Demand Savings**

This is only applicable to the electric steam cooker.

ΔkW = (ΔkWh/(HOURSDay \*DaysYear)) \* CF

Where:

|  |  |
| --- | --- |
| **Location** | **CF**  **CF** |
| Fast Food Limited Menu | 0.32 |
| Fast Food Expanded Menu | 0.41 |
| Pizza | 0.46 |
| Full Service Limited Menu | 0.51 |
| Full Service Expanded Menu | 0.36 |
| Cafeteria | 0.36 |

CF =Summer Peak Coincidence Factor for measure is provided below for different locations[[27]](#footnote-27):

DaysYear =Annual Days of Operation

=custom or 365.25 days a year

Other values as defined above

EXAMPLE

For 3 pan electric steam cooker located in a cafeteria:

ΔkW = (ΔkWh/(HOURSDay \*DaysYear)) \* CF

= (13,649/ (6 \* 365.25)) \* 0.36

= 2.24 kW

**Water Impact Descriptions and Calculation**

This is applicable to both gas and electric steam cookers.

ΔWater = (WBASE -WENERGYSTAR®)\*HOURSDay \*DaysYear

Where

WBASE = Water Consumption Rate of Base Steamer (gal/hr)

= 40[[28]](#footnote-28)

WENERGYSTAR = Water Consumption Rate of ENERGY STAR® Steamer look up[[29]](#footnote-29)

| **CEE Tier** | **gal/hr** |
| --- | --- |
| Tier 1A | 15 |
| Tier 1B | 4 |
| Avg Efficient | 10 |
| Avg Most Efficient | 3 |

DaysYear =Annual Days of Operation

=custom or 365.25 days a year[[30]](#footnote-30)

EXAMPLE

For example, an electric 3 pan steamer with average efficiency in a full service restaurant

ΔWater = (40 -10) \* 7 \* 365.25

= 76,703 gallons

**Deemed O&M Cost Adjustment Calculation**

N/A

###### Measure Code: CI-FSE-STMC-V04-160601

1. California DEER 2008 which is also used by both the Food Service Technology Center and ENERGY STAR®. [↑](#footnote-ref-1)
2. Source for incremental cost for efficient natural gas steamer is RSG Commercial Gas Steamer Workpaper, January 2012. [↑](#footnote-ref-2)
3. Source for efficient electric steamer incremental cost is $2,490 per 2009 PG&E Workpaper - PGECOFST104.1 - Commercial Steam Cooker - Electric and Gas as reference by KEMA in the ComEd C & I TRM. [↑](#footnote-ref-3)
4. Values taken from Minnesota Technical Reference Manual, ‘Electric Oven and Range’ measure and is based upon “Project on Restaurant Energy Performance-End-Use Monitoring and Analysis”, Appendixes I and II, Claar, et. al., May 1985.Unknown is an average of other location types [↑](#footnote-ref-4)
5. Food Service Technology Center 2011 Savings Calculator [↑](#footnote-ref-5)
6. Food Service Technology Center 2011 Savings Calculator [↑](#footnote-ref-6)
7. Production capacity per Food Service Technology Center 2011 Savings Calculator of 23.3333 lb/hr per pan for electric baseline steam cookers and 21.6667 lb/hr per pan for natural gas baseline steam cookers. ENERGY STAR® savings calculator uses 23.3 lb/hr per pan for both electric and natural gas baseline steamers. [↑](#footnote-ref-7)
8. Reference ENERGY STAR® savings calculator at http://www.energystar.gov/index.cfm?fuseaction=find\_a\_product.showProductGroup&pgw\_code=COC. [↑](#footnote-ref-8)
9. Reference Food Service Technology Center 2011 Savings Calculator values as used by Consortium for Energy Efficiency, Inc. for baseline electric and natural gas steamer heavy cooking load energy efficiencies. [↑](#footnote-ref-9)
10. Values taken from Minnesota Technical Reference Manual, ‘Electric Oven and Range’ measure and is based upon “Project on Restaurant Energy Performance-End-Use Monitoring and Analysis”, Appendixes I and II, Claar, et. al., May 1985. [↑](#footnote-ref-10)
11. Unknown is average of other locations [↑](#footnote-ref-11)
12. Reference amount used by both Food Service Technology Center and ENERGY STAR® savings calculator [↑](#footnote-ref-12)
13. Reference information from the Food Service Technology Center siting that ENERGY STAR® steamers are not typically operated in constant steam mode, but rather are used in timed mode. Reference ENERGY STAR® savings calculator at http://www.energystar.gov/index.cfm?fuseaction=find\_a\_product.showProductGroup&pgw\_code=COC for efficient steamer. Both baseline & efficient steamer mode values should be considered for users in Illinois market. [↑](#footnote-ref-13)
14. Food Service Technology Center 2011 Savings Calculator [↑](#footnote-ref-14)
15. Production capacity per Food Service Technology Center 2011 Savings Calculator of 18.3333 lb/hr per pan for gas ENERGY STAR® steam cookers and 16.6667  lb/hr per pan for electric ENERGY STAR® steam cookers.  ENERGY STAR® savings calculator uses 16.7 lb/hr per pan for electric and 20 lb/hr for natural gas ENERGY STAR® steamers. [↑](#footnote-ref-15)
16. Reference Food Service Technology Center 2011 Savings Calculator values as used by Consortium for Energy Efficiency, Inc. for Tier 1A and Tier 1B qualified electric and natural gas steamer heavy cooking load energy efficiencies and http://www.energystar.gov/ia/partners/product\_specs/program\_reqs/Commercial\_Steam\_Cookers\_Program\_Requirements.pdf?7010-36eb [↑](#footnote-ref-16)
17. Reference ENERGY STAR® savings calculator at http://www.energystar.gov/index.cfm?fuseaction=find\_a\_product.showProductGroup&pgw\_code=COC and Food [↑](#footnote-ref-17)
18. Reference ENERGY STAR® savings calculator at http://www.energystar.gov/index.cfm?fuseaction=find\_a\_product.showProductGroup&pgw\_code=COC and Food [↑](#footnote-ref-18)
19. Ohio TRM which references 2002 Food Service Technology Center "Commercial Cooking Appliance Technology Assessment" Chapter 8: Steamers. This is time also used by ENERGY STAR® savings calculator at [http://www.energystar.gov/index.cfm?fuseaction=find\_a\_product.showProductGroup&pgw\_code=COC](http://www.bpa.gov/energy/n/reports/evaluation/residential/faucet_aerator.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COC). 11,000 Btu/preheat is from 72,000 Btu/hr \* 15 min/hr /60 min/hr for gas steamers and 0.5 kWh/preheat is from 6 kW/preheat \* 15 min/hr / 60 min/hr [↑](#footnote-ref-19)
20. Reference Food Service Technology Center 2011 Savings Calculator values for Baseline Preheat Energy. [↑](#footnote-ref-20)
21. Reference Food Service Technology Center 2011 Savings Calculator values as used by Consortium for Energy Efficiency, Inc. for baseline electric and natural gas steamer heavy cooking load energy efficiencies. [↑](#footnote-ref-21)
22. Ibid. [↑](#footnote-ref-22)
23. Amount used by both Food Service Technology Center and ENERGY STAR® savings calculator [↑](#footnote-ref-23)
24. Reference ENERGY STAR® savings calculator at http://www.energystar.gov/index.cfm?fuseaction=find\_a\_product.showProductGroup&pgw\_code=COC. [↑](#footnote-ref-24)
25. Ibid. [↑](#footnote-ref-25)
26. Ibid. [↑](#footnote-ref-26)
27. Values taken from Minnesota Technical Reference Manual, ‘Electric Oven and Range’ measure and is based upon “Project on Restaurant Energy Performance-End-Use Monitoring and Analysis”, Appendixes I and II, Claar, et. al., May 1985. [↑](#footnote-ref-27)
28. FSTC (2002). Commercial Cooking Appliance Technology Assessment. Chapter 8: Steamers. [↑](#footnote-ref-28)
29. Source Consortium for Energy Efficiency, Inc. September 2010 "Program Design Guidance for Steamers" for Tier 1A and Tier 1B water requirements. Ohio Technical Reference Manual 2010 for 10 gal/hr water consumption which can be used when Tier level is not known. [↑](#footnote-ref-29)
30. Source for 365.25 days/yr is ENERGY STAR® savings calculator which references Food Service Technology research on average use, 2009. [↑](#footnote-ref-30)