

**On-Site Energy Monitoring of a Two-Group
Espresso Machine**
Special Report

FSTC Report 5011.00.91

Food Service Technology Center Manager: Don Fisher
Final Report December 2000

Prepared by:
Richard Young
Judy Nickel

Fisher-Nickel, Inc.
Danville, CA 94526

Prepared for:
Pacific Gas and Electric Company
Customer Energy Management Department
123 Mission Street, P.O. Box 770000
San Francisco, California 94177

© 2000 by Pacific Gas and Electric Company. All rights reserved.



The information in this report is based on data generated at PG&E's Food Service Technology Center.

Acknowledgments

This program is funded by California utility customers and administered by Pacific Gas and Electric Company under the auspices of the California Public Utilities Commission.

A National Advisory Group provides guidance to the Food Service Technology Center Project. Members included:

Electric Power Research Institute (EPRI)

Gas Research Institute (GRI)

National Restaurant Association

California Restaurant Association (CRA)

International Facility Management Association (IFMA)

California Energy Commission (CEC)

Underwriters Laboratories (UL)

California Café Restaurant Corp.

Darden Restaurants, Inc.

Safeway, Inc.

Round Table Pizza

McDonald's Corporation

University of California at Riverside

University of California at Berkeley

Enbridge\Consumers Gas

Specific appreciation is extended to Richard and Ann Lauer for allowing the Food Service Technology Center to monitor the espresso machine at *Rick and Ann's*, their restaurant in Berkeley, California.

Policy on the Use of Food Service Technology Center Test Results and Other Related Information

- The Food Service Technology Center (FSTC) is *strongly* committed to testing food service equipment using the best available scientific techniques and instrumentation.
- The FSTC is neutral as to fuel and energy source. It does not, in any way, encourage or promote the use of any fuel or energy source nor does it endorse any of the equipment tested at the FSTC.
- FSTC test results are made available to the general public through Pacific Gas & Electric Company technical research reports and publications and are protected under U.S. and international copyright laws.
- In the event that FSTC data are to be reported, quoted, or referred to in any way in publications, papers, brochures, advertising, or any other publicly available documents, the rules of copyright must be strictly followed, including written permission from PG&E *in advance* and proper attribution to PG&E and the Food Service Technology Center. In any such publication, sufficient text must be excerpted or quoted so as to give full and fair representation of findings as reported in the original documentation from FSTC.

Legal Notice

This report was prepared by Pacific Gas and Electric Company for exclusive use by its employees and agents. Neither Pacific Gas and Electric Company nor any of its employees:

- (1) makes any written or oral warranty, expressed or implied, including, but not limited to those concerning merchantability or fitness for a particular purpose;
- (2) assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, process, method, or policy contained herein; or
- (3) represents that its use would not infringe any privately owned rights, including, but not limited to, patents, trademarks, or copyrights.

Contents

	Page
Executive Summary	iii
1 Introduction	1-1
Background.....	1-1
Objective	1-2
The Restaurant Site.....	1-2
Espresso Machine Description and Operation.....	1-3
2 Production Monitoring	2-1
Energy	2-1
Estimated Annual Energy Cost.....	2-3
Drink Production	2-4
3 Energy Efficiency	3-1
Potential Energy Savings.....	3-1
Operational Energy Savings.....	3-1
Energy Efficient Design	3-3
4 Conclusions and Recommendations	4-1
Energy Monitoring.....	4-1
Energy Savings.....	4-1
Appendix A: Glossary	

Contents

Figures		Page
1-1	Rick and Ann's Restaurant and Pantry	1-4
1-2	Espresso machine in production	1-5
2-1	Typical day energy consumption profiles	2-2

Tables		Page
1-1	Espresso Machine Specifications	1-5
2-1	Espresso Machine Energy Consumption Summary.....	2-3

Executive Summary

This Pacific Gas & Electric Company Food Service Technology Center (FSTC) research report presents the results of on-site monitoring of a two-group, two-wand espresso machine as it was used for routine menu production in a restaurant. Energy consumption data were recorded during one-minute intervals, 24 hours a day over the course of three months. The menu and overall energy consumption of the restaurant as well as the staff and weather conditions remained consistent throughout the monitoring period.

The goal of this monitoring project was to quantify the energy consumption of an espresso machine in a café/restaurant application, which is typical for this size and style of machine. The production demands in this type of installation range from light to moderate with occasional heavy usage during relatively short peak periods. [The heavy energy consumption during these peak periods would be more representative of the type of daily production demands found in a coffee house installation.] This information was then used to investigate potential energy savings from both an operational and a design perspective.

The researchers augmented the energy monitoring with observations of the machine in production, interviews with the staff and owner and a tally of the drinks served on two typical days. All espresso drinks, with the exception of cappuccino, were made with a double shot of espresso. The estimated output of the machine during peak times was 10 to 20 double shots, along with steam for steamed milk and a significant amount of hot water for hot tea and cocoa. Estimated total output was 50 to 80 drinks per day. This figure includes employee consumption, which sometimes occurred before and after the restaurant's serving hours.

Executive Summary

A summary of the energy monitoring results is presented in Table ES-1.

Table ES-1 Espresso Machine Energy Consumption Summary.

Model	LaSpaziale Model 3000NewEk
Nameplate Rating (European Installation)	380V, 3ph, 50hz, 3kW
Actual Installed Rating	224V, 1ph, 60hz, 3.6kW
Idle Energy Rate (Watts)	550
Average Energy Input Rate During 17 Hours of Production (Watts)	700
Average Energy Input Rate for Entire 24 Hour Day (Watts)	660
Average Energy Input Rate During Light Production (Watts)	625
Average Energy Input Rate During Heavy Production (Watts)	800
Production Energy Use (kWh/day) ^a	11.9
Nighttime Idle Energy Use (kWh/day)	3.9
Total Energy Use (kWh/day)	15.8
Appliance On-Time (h/d)	24
Production Hours (h/d)	17
Nighttime Idle Hours (h/d)	7
Production Duty Cycle (%)	19.4

^a Includes idle energy over the hours of operation when espresso machine was in use.

There were 17 hours of production operation for the espresso machine, from 6 am to 11 pm. During these hours, the espresso machine consumed 11.9 kWh/day, the average energy input rate was 700 watts and the production duty cycle was 19.4%.

The average energy input rate was 880 watts during the heaviest production hours, 6:30 am to 2:30 pm, and 625 watts during the light production hours from 2:30 pm to 10 pm. The average energy input rate was 550 watts during the nighttime idle period when the machine was not used and the energy in

Executive Summary

put rate over the entire 24-hour day averaged 660 watts. The espresso machine consumed a total of 15.8 kWh/day.

During one year (365 days) of operation, the espresso machine would consume 5,767 kWh. The restaurant where the espresso machine is located has an average energy cost of \$0.0993/kWh. Based on this energy cost, the total yearly cost to operate the espresso machine would be \$573 or about \$0.025 per drink.

FSTC Manager



Donald R. Fisher

Senior Program Manager



Peter W. Turnbull

1 Introduction

Background

Espresso machines have gained a prominent place in food service due to the growth in demand for coffee drinks. Considered a standard in many European cafes and restaurants, espresso machines are now found across the United States in a variety of installations including fine dining, diners, cafes, coffee houses and even quick service restaurants and convenience stores. They represent a relatively easy way to add a high profit menu item to a food service operation without requiring much additional space or ventilation.

The majority of espresso machines installed in the United States are manufactured in Europe and while there have been significant gains in the controls technologies that operate these machines, the basic internal construction and process of making espresso has changed very little since the first hydraulic machine was released to market in 1960. A typical espresso machine consists of one or more groups and one or more steam wands, which are used for steaming and frothing milk. In the group, near-boiling water is pumped through finely ground coffee under a pressure of about 9 atmospheres, producing a small “creamy” cup of coffee. The espresso machine might also include a hot water spigot used for tea or other hot drinks. Typically, the boilers in espresso machines are not insulated and the machines are never turned off. Waste heat from the boiler is often used to preheat coffee cups stored on top of the machine.

The Food Service Technology Center (FSTC) monitored the energy consumption of a two-group, two-wand espresso machine with a hot water spigot as it was used for routine menu production in a restaurant. The researchers also generated an estimate of the daily drink production based on observation, interviews and a tally of the drinks served on two typical days.

Introduction

The glossary in Appendix A is provided so that the reader has a quick reference for the terms used in this report.

Objective

The goal of this monitoring project was to quantify the energy consumption of an espresso machine in a café/restaurant application, which is typical for this size and style of machine. The production demands in this type of installation range from light to moderate with occasional heavy usage during relatively short peak periods. [The heavy energy consumption during these peak periods would be more representative of the type of daily production demands found in a coffee house installation.] This information was then used to investigate potential energy savings from both an operational and a design perspective.

The Restaurant Site

The espresso machine monitored for this study is located at Rick and Ann's Restaurant in Berkeley, CA. Founded in 1990, this restaurant seats approximately 50 diners indoors and another dozen outside on the patio. Rick and Ann's features an American-style "comfort foods" menu and is consistently busy with most seats filled during serving hours. The serving hours are from 8 am to 2:30 pm every day and from 5:30 pm to 9:30 pm six days a week. The dining room is closed on Monday nights. The restaurant also includes Rick and Ann's Pantry, where walk-up customers can purchase carryout items including coffee drinks. The espresso machine is physically located in the Pantry, but primarily serves the sit down portion of the restaurant.

The espresso machine was monitored using a Pacific Science and Technology (PS&T) Elite 4 portable datalogger. Energy consumption data were recorded during one-minute intervals, 24 hours a day over the course of three months.

The researchers reviewed Rick and Ann's historical energy consumption over several years and determined that the overall energy consumption was

Introduction

very consistent from month to month and year to year. This can be attributed to the mild weather of Berkeley, California, the popularity of the restaurant, the excellent management of the restaurant, the consistent menu and the low staff turnover. This was advantageous to the monitoring project because the data gathered during the monitoring period would be representative of the typical energy consumption throughout the year.

Figure 1-1 shows the exterior of Rick and Ann's Restaurant and the location of the espresso machine in Rick and Ann's Pantry.

Espresso Machine Description and Operation

The monitored espresso machine was a two-group, two-wand, LaSpaziale Model 3000 NewEk. It included a hot water spigot and both manual and automatic controls. The nameplate rating on the machine indicated that it was three phase, 380 V, 50 Hz and 3 kW but the machine had been reconfigured for the US market and was actually installed single phase, 220 V, 60 Hz and 3.6 kW.

The restaurant staff used the automatic dosemetric controls for all espresso production. All coffee drinks, with the exception of cappuccino, were made with a double shot of espresso. Most of the coffee drinks served included steamed milk. The staff used the hot water spigot for hot tea and cocoa, which comprised about half of the total drinks produced using the espresso machine.

The espresso machine's specifications are presented in Table 1-1 and Figure 1-2 shows the espresso machine in production.

Introduction



Figure 1-1.
Rick and Ann's Restaurant
and Pantry

Introduction

Table 1-1 Espresso Machine Specifications.

Generic Appliance Type:	Two-Group, Two-Wand, Single Boiler, Espresso Machine
Manufacturer:	LaSpaziale
Model:	3000 NewEk
Rated Energy Input:	3.6 kW
Dimensions:	27.6" x 21.6" x 18.1"
Construction:	Steel and Stainless Steel
Controls:	Manual and automatic portion controls for each espresso group. Manual controls for each steam wand. Manual control for hot water spigot. Manual off/on control and boiler pressure gage.



Figure 1-2.
Espresso machine in
production

2 Production Monitoring

Energy

The energy consumption of the espresso machine was monitored during August, September, and October of 2000. During this time, the machine remained on for 24 hours a day. The researchers separated the energy consumed during the production hours, when the machine was being used, and the energy that was consumed during the nighttime when the machine was idling (i.e., not being used).

The energy consumption profile plotted in Figure 2-1 characterizes the typical day energy use for the espresso machine on both a slower weekday and a busy weekend day. The energy profile on the busier days tended towards higher peak usage during the morning hours. The difference in overall energy consumption between the busiest and slowest days was only about 500 watt-hours. The energy consumption data in Figure 2-1 are presented based on 1-hour averages. The graph also highlights the serving hours of the restaurant. There is some use of the espresso maker outside of the restaurant serving hours and this can be attributed to both carryout orders and employee consumption.

Production Monitoring

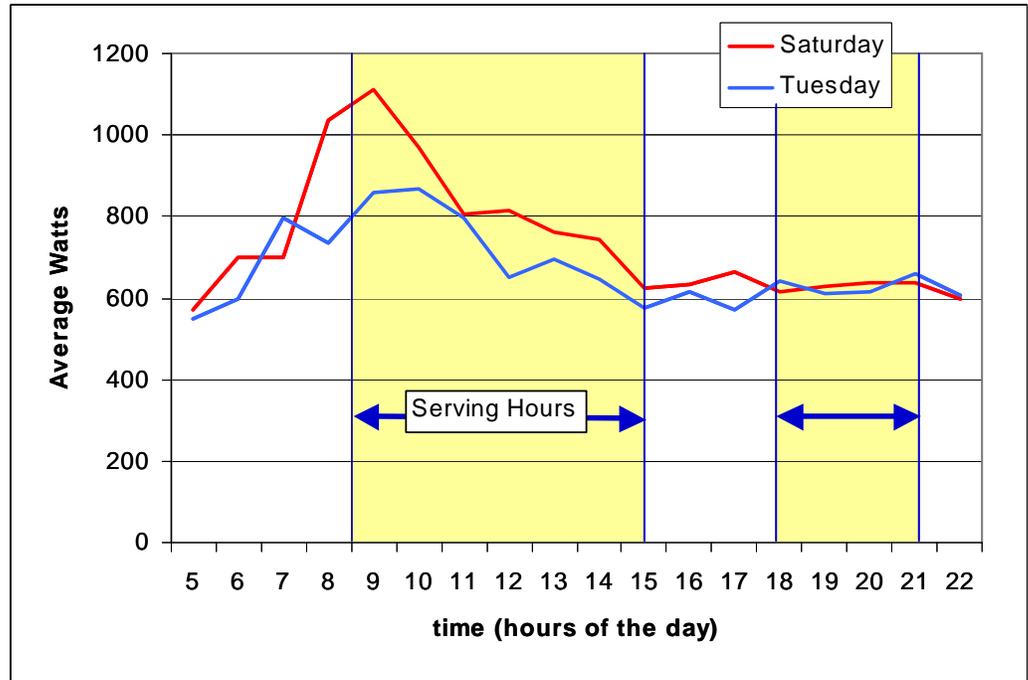


Figure 2-1.
Typical day energy
consumption profiles.

There were 17 hours of production operation for the espresso machine, from 6 am to 11 pm. During these hours, the espresso machine consumed 11.9 kWh/day, the average energy input rate was 700 watts and the production duty cycle was 19.4%.

The average energy input rate was 880 watts during the heaviest production hours, 6:30 am to 2:30 pm, and 625 watts during the light production hours from 2:30 pm to 10 pm. The average energy input rate was 550 watts during the nighttime idle period when the machine was not used and the energy input rate over the entire 24-hour day averaged 660 watts. The espresso machine consumed a total of 15.8 kWh/day.

During one year (365 days) of operation, the espresso machine would consume 5,767 kWh. The restaurant where the espresso machine is located has

Production Monitoring

an average energy cost of \$0.0993/kWh. Based on this energy cost, the total yearly cost to operate the espresso machine would be \$573 or about \$0.025 per drink.

A summary of the energy monitoring results is presented in Table 2-1.

Table 2-1 Espresso Machine Energy Consumption Summary.

Peak Energy Input Rate (kW)	3.6
Idle Energy Rate (Watts)	550
Average Energy Input Rate During 17 Hours of Production (Watts)	700
Average Energy Input Rate for Entire 24 Hour Day (Watts)	660
Average Energy Input Rate During Light Production (Watts)	625
Average Energy Input Rate During Heavy Production (Watts)	800
Daily Production Energy Use (kWh/day) ^a	11.9
Nighttime Idle Energy Use (kWh/day)	3.9
Total Energy Use (kWh/day)	15.8
Appliance On-Time (h/d)	24
Production Hours (h/d)	17
Nighttime Idle Hours (h/d)	7
Production Duty Cycle (%)	19.4

^a Includes idle energy over the hours of operation when espresso machine was in use.

Estimated Annual Energy Cost

Based on the average daily energy consumption, during one year (365 days) of operation, the espresso machine would consume 5,767 kWh and increase the billing demand for the facility by 700 watts. This estimated average contribution to demand is based on the average energy input rate during the production hours and assumes that the appliance is operating when the maximum building demand occurs. Both the annual energy consumption and estimated demand for this espresso machine are based on the production demands at the monitored restaurant and both could vary based on the

Production Monitoring

production demands of another facility. The restaurant where the espresso machine is located has an average energy cost, including demand, of \$0.0993/kWh. Based on this energy cost, the total yearly cost to operate the espresso machine would be \$573 or about \$0.025 per drink.

Drink Production

The researchers augmented the energy monitoring with observations of the machine in production, interviews with the staff and owner and a tally of the drinks served on two typical days.

All espresso drinks, with the exception of cappuccino, were made with a double shot of espresso. The estimated output of the machine during peak times was 10 to 20 double shots, along with steam for steamed milk and a significant amount of hot water for hot tea and cocoa.

Based on a tally of the drinks served on a typical Thursday and a typical Saturday, cappuccino represented less than 10% of the total drink production while Lattes and Mochas represented about half the total production. About one third of total drink production was dedicated to hot tea. Estimated total output was 50 to 80 drinks per day. This figure includes employee consumption, which sometimes occurred before and after the restaurant's serving hours.

3 Energy Efficiency

Potential Energy Savings

One of the prime motivators for monitoring the energy consumption of the espresso machine was to investigate the potential to save energy either through better operation or more efficient design. The researchers identified two potential ways to reduce the energy consumption of the espresso machine.

Operational Energy Savings

The management at Rick and Ann's are very conscious of energy consumption and are diligent about turning off any cooking equipment that is not in use; however, the espresso machine remains on 24 hours a day. This is typical of virtually every espresso machine installation that the researchers have encountered, including the chain coffee houses.

The monitored espresso machine was not used at all at nighttime and could potentially be turned off for seven hours a day. This action would save 1,400 kWh per year resulting in a cost savings of \$139 – almost 25% of the total cost to operate the machine. These savings would be substantial if they could be multiplied by the thousands of small and large espresso machines installed throughout the US.

The researchers interviewed several end users, both large and small, as well as US representatives of the espresso machine manufacturers to ascertain why these machines are never turned off. Typically, the small end users had either never considered this option or were worried about the early morning preheat that would be required to restart the machine. Some had considered turning the machine off, but were usually instructed by the manufacturer's representatives to leave the machine on. The manufacturer's representatives and service people feel that the

expansion and contraction that occurs when the machine is cycled on and off from hot to cold tends to loosen the internal fittings and stress any welds in the boiler. Since any failure of an espresso machine is extremely costly, both in lost sales and service fees, end users tend to avoid this risk through continuous, stabilized operation of the machines. To date, the researchers have been unable to locate any empirical data that could show cause and effect between turning the machine off at night and early failure of the boiler system. Similarly, the researchers were unable to find any reliable anecdotal evidence that could be used to estimate the increase in failure due to turning the machine off.

While it is reasonable that dissimilar metals used to join components of a high-temperature and high-pressure system might fail under fluctuating temperature and pressure conditions, the lack of any study makes it difficult to know how dramatic this affect is. Espresso machine manufacturers recommend regular maintenance of their units including periodic replacement of the boiler gaskets. It may be possible for a well maintained espresso machine to be turned off without harming its components; however, no recommendation can be made without further study of this question.

One of the largest end users cited water quality issues as a reason for not turning their espresso machines off at night. They felt that the dissolved solids contained in the hot boiler water would fall out of suspension when the boiler temperature dropped and that the particles would speed up degradation of the boiler elements and clog up the machine's tiny orifices. To counteract this problem, they are using water treatment and espresso machines with a boiler blow-down function. They have studied espresso machine energy consumption in their coffee house operations and are interested in saving energy. The resolution of their water quality issues could facilitate an energy management program that includes nighttime turn-off of their espresso machines.

Energy Efficiency

Energy Efficient Design

The boiler on the monitored espresso machine was not insulated. While it is technically possible to insulate the boiler, this is not typically done. The waste heat generated by the un-insulated boiler is simply vented out the top of the machine, where it can be used to heat cups stored on top of the unit.

The idle energy rate of the espresso machine was 550 watts. This is equal to the amount of heat the unit gives off just to stay in a ready state condition. Assuming that insulation on the boiler could reduce the unit's heat loss by 50%, the annual energy savings would amount to 2,409 kWh or about \$240. This represents 42% of the total energy consumption of the espresso machine.

Reducing the heat loss of the espresso machine would also reduce the amount of air conditioning energy required to cool the space, as well as making the work environment better for the employees. A 50% reduction in heat loss would still leave plenty of heat to warm the cups on top of the unit.

4 Conclusions and Recommendations

Energy Monitoring

The researchers were successful in monitoring and characterizing the energy consumption of a typical two-group espresso machine as used in a restaurant setting. They were also able to gather drink production data, which is helpful in understanding how the servers used the machine. The usage of the machine was typical of many café/restaurant applications as it was used to make standard coffee drinks, composed of espresso and steamed milk, as well as tea using the hot water spigot. Although the number of drinks served (50 to 80 per day) would be considered “light” compared to high-volume coffee house operations, it was considered representative of a large installed base of espresso machines located in a variety of installations including fine dining, diners, cafes, quick service restaurants and even convenience stores.

Energy Savings

The espresso machine consumed 15.8 kWh per day at an average input rate of 660 watts and the researchers investigated two potential paths for reducing energy consumption. Firstly, the machine could potentially be turned off at nighttime, which would lower its energy consumption by about 25%. Secondly, the unit’s energy consumption could easily be reduced by as much as 42% by redesigning the unit with an insulated boiler. Both of these options merit further study when weighed against the fact that energy savings could be multiplied by the thousands of espresso makers currently in operation.

A Glossary

Appliance On-Time (minute, hour)

Hours of Operation

Operating Period

Operating Time

The total period of time that an appliance is operated (from the perspective of food service staff) from the time it is turned “on” to the time it is turned “off.”

Appliance on-time excludes any “off” periods between the first and last appliance operation.

Average Daily Production Energy Consumption Rate

(kW or kBtu/h)

The average rate of production energy consumption based on the daily production energy consumption and the appliance operating or “on” time.

Average Daily Production Energy Rate =

$$\frac{\text{Daily Production Energy Consumption}}{\text{Appliance On - Time}}$$

Note: By basing the total daily production energy consumption on a 24-hour period, the total quantity of pilot energy (if applicable) is considered within the average production energy consumption rate and is based on the actual period of appliance usage.

Average Production Energy Consumption Rate (kW or kBtu/h)

Average Production Energy Rate

Average Production Energy Use Rate

The average rate of production energy consumption based on the production energy consumption and the appliance operating or “on” time for a specified period of appliance operation.

Average Production Energy Consumption Rate =

$$\frac{\text{Production Energy Consumption}}{\text{Operating Time}}$$

Baseload Energy Consumption (Btu or kBtu)

Baseload Energy

The total amount of energy that would be consumed over the operating period of an appliance if it had never been used to cook food.

Baseload Energy Consumption Rate (kW or kBtu/h)

Base Rate

Baseload Energy Rate

Baseload Rate

The lowest rate of energy consumption reflected by the energy consumption profile (based on a 15-minute sliding window average) recorded during appliance operation. Generally, this definition is not extended to include the rate of pilot energy consumption. It is typically equal to the lowest value of idle energy consumption rate.

Cold Zone

The volume in the fryer below the heating element(s) or heat exchanger surface designed to remain cooler than the fry zone and hot zone.

Cook Zone

Cooking Zone

The volume of oil in the fryer where the fries are cooked. Typically, the entire volume from the heating element(s) of a heat exchanger surface to the surface of the frying medium.

Cooking Energy Consumption (kWh or kBtu)

The total energy consumed by an appliance during the cooking period.

Cooking Energy Consumption Rate (kW or kBtu/h)

The average rate of energy consumption during the cooking period.

Cooking Energy Efficiency

The quantity of energy input to the food products; expressed as a percentage of the quantity of energy input to the appliance during the heavy-, medium-, and light-load test.

Cooking Period (minute, hour)

The period of time (derived from in-kitchen monitoring or by interpreting the energy consumption profile) that an appliance is actually used for cooking.

Glossary

Daily Energy Consumption (kWh or kBtu)

Daily Energy Use

Daily Production Energy Consumption

Daily Production Energy Use

The total amount of energy consumed by an appliance as it is used within the Production-Test Kitchen over a 24-hour period.

Note: By basing the total daily production energy consumption on a 24-hour period, the total quantity of pilot energy (if applicable) is considered within the average production energy consumption rate.

Energy Consumption Profile

Energy Use Profile

A plot of appliance energy consumption showing energy consumption rate on the Y-axis and time on the X-axis.

Note: The area under the curve (plot) represents the total energy consumption for the period of integration. For uniformity in production reports, use the following terms and units for the coordinate labels:

y-axis: Energy Rate (kW or kBtu/h)

x-axis: Time (AM & PM): (Hour)
(Min)

Energy Consumption Rate (kW or kBtu/h)

Energy Input Rate

Energy Rate

The rate of appliance energy consumption over a specified period of operation (see Energy Consumption Profile).

Energy Use Data Set

A set of daily energy consumption data compiled in accordance with typical day criteria.

Hot Zone

The area surrounding the heating element(s) or heat exchanger surface.

Idle Energy Consumption (kWh or kBtu)

Idle Energy Use

The amount of energy consumed by an appliance operating under an idle condition over the duration of an idle period.

Idle Energy Consumption Rate (kW or kBtu/h)

Idle Energy Input Rate

Idle Energy Rate

Idle Rate

The rate of appliance energy consumption while it is “idling” or “holding” at a stabilized operating condition or temperature.

Idle Duty Cycle (%)

Idle Energy Factor

Idle Load Factor

The idle energy consumption rate expressed as a percentage of the measured energy input rate.

Idle Energy Factor =

$$\frac{\text{Idle Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100$$

Idle Temperature (°F, Setting)

The temperature of the cooking cavity/surface (selected by the appliance operator or specified for a controlled test) that is maintained by the appliance under an idle condition.

Idle Time (minutes, hour)

Idle Period

A period of time that an appliance is consuming energy at its idle energy consumption rate while maintaining a specified stable operating condition or temperature.

Note: Idle time may include both necessary or unnecessary appliance “idling.” This is simply differentiated by applying the appropriate adjective to the idle energy period term (e.g., needless idle time, necessary idle period.)

Glossary

Measured Energy Input Rate (kW, W or kBtu/h, Btu/h)

Measured Input

Measured Peak Energy Input Rate

Peak Rate of Energy Input

The maximum or peak rate at which an appliance consumes energy, measured during appliance pre-heat or while conducting a water-boil test (i.e., the period of operation when all burners or elements are “on”)

Pilot Energy Consumption (kBtu)

Pilot Energy Use

Standing or Constant Pilot Energy Consumption

Standing or Constant Pilot Energy Use

The amount of energy consumed by the standing pilot of an appliance over a specified period of time.

Pilot Energy Rate (kBtu/h)

Average Pilot Energy Rate

Average Pilot Energy Use Rate

Pilot Energy Consumption Rate

The rate of energy consumption by the standing or constant pilot while the appliance is not being operated (i.e., when the thermostats or control knobs have been turned off by the food service operator).

Preheat Energy Consumption (kWh or kBtu)

Preheat Energy

The total amount of energy consumed by an appliance during the preheat period.

Note: The reporting of preheat energy must be supported by the specified temperature/operating condition.

Preheat Energy Rate

The rate of appliance energy consumption while it is “preheating” to a predetermined temperature.

Preheat Time (minute, hour)

Preheat Period

The time required for an appliance to “preheat” from the ambient room temperature ($75 \pm 5^\circ\text{F}$) to a specified (and calibrated) operating temperature or thermostat set point.

Production Day

Production Period

The time period when an appliance is used by the kitchen staff, typically between the hours of 5 A.M. and 10 P.M.

Production Duty Cycle (%)

Load Factor

Production Energy Factor

Production Factor

The average production energy consumption rate (based on a specified operating period for the appliance) expressed as a percentage of the measured energy input rate.

Production Duty Cycle =

$$\frac{\text{Average Production Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100$$

Production Energy Consumption (kWh or kBtu)

Production Energy Use

The total amount of energy consumed by an appliance as it is used within the Production-Test Kitchen over a specified time period (e.g., 10 A.M. to 1 P.M., dinner period). Production energy consumption is numerically equal to daily energy consumption if the production period is not specified.

Note: This integrated energy use includes preheat energy, idle energy, and pilot energy associated with the specified time period.

Rated Energy Input Rate (kW, W or kBtu/h, Btu/h)

Input Rating (ANSI definition)

Nameplate Energy Input Rate

Rated Input

The maximum or peak rate at which an appliance consumes energy as rated by the manufacturer and specified on the nameplate.

Glossary

Typical Day

A selected day of energy usage based on predetermined criteria that will generate a production energy consumption profile reflecting typical production usage for a specific appliance. The typical day criteria may comprise:

- Typical day energy consumption should approximate average daily energy consumption for energy use data set.
- A specified number of appliance operations and/or cooking periods (e.g., lunch and dinner only).
- A specified range in operating hours.
- A specified mode of operation (or combination of modes) may be associated with a typical day's operation