Griddles are used in restaurants from the first order of bacon at breakfast to the last seared steak at dinner. The griddle is a “workhorse” that usually occupies a central position on the short-order line. All griddles share a common basic design. Food is cooked on a flat metal plate at temperatures between 200 and 450°F. The desired characteristics of this style of cooking are crisping and browning, for foods like hashbrown potatoes, bacon and pancakes; searing, for foods like hamburgers, chicken, steak and fish; and warming or toasting, for bread and buns. For a high production fast food restaurant, temperature uniformity of the griddle surface is also important to assure that the food product is fully cooked.

Gas griddles are constructed using a 1/2 - 1 inch thick steel plate which has splash guards attached to the sides and rear and a shallow trough to guide grease and scraps into a holding tray. The cooking surface is usually 24 - 30 inches deep, with nominal widths from 2 to 8 feet. This griddle plate is heated from underneath by gas burners with typically one control per burner along the front of the appliance. Although high-efficiency gas griddles are thermostatically controlled, manual control (similar to a range top burner) is still common on lower cost models. Griddles may be freestanding floor models, countertop units, or incorporated as part of a range. Most manufacturers offer grooved griddle plates as an option, designed to emulate the searing of an underfired charbroiler. Some manufacturers have introduced griddles with a
chrome surface that is easier to clean and also radiates less heat towards the chef and into the kitchen.

Innovations in burner design and application, such as infrared (IR) burners, have dramatically improved the performance of gas griddles available in the marketplace. High-efficiency gas griddles can consume up to 30 percent less energy than standard-efficiency griddles, which use mostly atmospheric burners. High-efficiency gas griddles also provide higher output (i.e., increased throughput or productivity measured in lb/h) than standard efficiency griddles. The more heat that is transferred from the combustion process to the griddle plate, the higher the production capacity and the lower the energy cost. To the restaurateur, the more product per Btu the better.

How This Technology Saves Energy

Gas griddles are constructed using a 1/2 - 1 inch thick steel plate which has splash guards attached to the sides and rear and a shallow trough to guide grease and scraps into a holding tray. The cooking surface is usually 24 - 30 inches deep, with nominal widths from 2 to 8 feet. This griddle plate is heated from underneath by gas burners with typically one control per burner along the front of the appliance. Although high-efficiency gas griddles are thermostatically controlled, manual control (similar to a range top burner) is still common on lower cost models. Griddles may be freestanding floor models, countertop units, or incorporated as part of a range. Most manufacturers offer grooved griddle plates as an option, designed to emulate the searing of an underfired charbroiler. Some of manufacturers have introduced griddles with a chrome surface that is easier to clean and also radiates less heat towards the chef and into the kitchen. A typical gas-fired griddle is shown in Figure 1.

The energy consumption and associated cost of operating a gas griddle can vary significantly (e.g., $300 - $3000 per year) depending on its size, usage (i.e., hours of operation, quantity of food cooked) and its efficiency. The range in energy consumption is proportional to the range in efficiency shown in Figure 2 and Table 1. The amount of energy required to idle a griddle also impacts operating cost, as a griddle may spend many hours per day in a “ready-to-cook” mode. Historically, this range in griddle energy performance has not been documented and, as a result, the first cost of an appliance has had a strong influence on the purchasing decision.

1 Bold italicized words are defined in the section titled “Definition of Key Terms.”
High efficiency gas griddles save energy by transferring a greater percentage of the heat produced by the combustion process to the griddle plate that is used to cook the food product. This is accomplished by optimizing combustion and/or improving the effectiveness of heat transfer from the “flame” to the “food.” Manufacturers typically improve gas griddle performance by:

- **Reducing the quantity of excess air** using powered burners to deliver an optimum quantity of combustion air to the burner and reduce the amount of heat vented through the flue. This strategy usually includes the application of an infrared burner.

- **Improving heat transfer efficiency** between the burner and the bottom of the griddle plate.

- **Incorporating more accurate (solid state) thermostats** to minimize temperature overshoot following griddle **preheat** or **recovery time** after cooking a heavy load. Modulating burner control may be incorporated, also contributing to higher energy efficiency.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rated Energy Input</strong> (kBTU/h)</td>
<td>60 - 120</td>
<td>60 - 100</td>
</tr>
<tr>
<td><strong>Cooking Energy Efficiency (%)</strong></td>
<td>35</td>
<td>50</td>
</tr>
<tr>
<td><strong>Ideal Energy Rate</strong> (kBTU/h)</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td><strong>Avg. Production Energy Cons. Rate</strong> (kBTU/h)</td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>

*Table 1: Typical Energy Performance of Gas 3-ft. Griddles*
Types of Energy Efficiency Measures

As reflected in Figure 2, there is a significant bandwidth in the efficiency of gas griddles. At the high end, various new technologies are incorporated into griddle design, yielding more efficient griddles with greater productivity. Among the new technologies already in place are powered infrared (IR) burners and solid state controls. Large quick-service chains have driven advancements in griddle performance, demanding energy efficiency, higher productivity and improved temperature distribution across the cooking surface.

Infrared Burners

Infrared burners employ a fine honeycomb matrix to evenly disperse the fuel/air mixture across the burner surface. Combustion takes place close to the burner surface, causing it to become “red-hot” (1,800°F) and emit infrared radiation to the griddle plate above. The heat transfer rate is greater with hotter flue gases moving across the heat exchanger surfaces. Excess air dilutes the combustion products and lowers the temperature of the gases. IR burners operate with less than 10 percent excess air, reducing the energy removed by the flue. Due to their potentially high first cost and maintenance cost, IR burners represent only 5% to 10% the gas griddles in the marketplace.

Solid State Controls

Advanced gas griddles are thermostatically controlled. They utilize solid state thermostats to control the temperature of the griddle surface. Energy is saved by preventing the griddle plate from exceeding the temperature of the thermostat set point.

Chrome Surface

Two manufacturers market griddles with an industrial chrome surface that reduces the radiant heat to the kitchen. This reduces the heat losses from the griddle surface towards the chef and into the surrounding kitchen area. The reduction of heat losses from the griddle surface can reduce the associated idle energy consumption of the griddle.

Applicability

Griddles are a common piece of equipment found in both institutional and non-institutional food service facilities. High-efficiency, advanced gas griddles may be substituted for standard efficiency griddles in any of the commercial food service applications shown in Table 2.

Field Observations to Assess Feasibility

This section discusses actions that can be taken to ensure that gas griddle efficiency technologies are applied properly and achieve cost-effective energy savings.

Related to Applicability

High-efficiency gas griddles will match or exceed the performance of older, low-efficiency models. Advanced gas griddles should be considered when-
ever new gas equipment is being purchased, particularly for applications with longer operating hours (e.g., 12 - 24 hours per day).

**Related to Energy Savings**

The energy cost savings of a high-efficiency griddle over a standard efficiency griddle may not be large enough to justify a griddle replacement. However, griddles do not last forever, and when it does come time to replace a griddle, it is important that the operator understand the economic advantage (through increased performance and reduced energy cost) of purchasing an advanced gas model.

The following operating tips will help to reduce the cost associated with operating a griddle. These measures are applicable to both high-efficiency and standard efficiency griddles.

- **Set up an appliance schedule**—reduce unnecessary idle time by leaving the griddle off until it is needed. More importantly, shut the griddle off as soon as no more orders are going to be cooked. Every extra hour a gas griddle is unnecessarily on could cost $30 - $60 per year.

- **Keep sections of griddles turned down** or off unless they are needed.

**Related to Implementation Cost**

Advanced technologies have a higher first cost, and in some cases, higher maintenance costs. These costs must be factored into the economic analysis when purchasing an advanced gas griddle.

**Estimation of Energy Savings**

Typical griddle usage involves one or two preheats over a 6 to 24 hour operating day. The following calculations

<table>
<thead>
<tr>
<th>Institutional Food Service</th>
<th>Non-Institutional Food Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colleges/Universities</td>
<td>Full-Service and Quick-Service Restaurants</td>
</tr>
<tr>
<td>Schools</td>
<td>Take-out and Delivery</td>
</tr>
<tr>
<td>Military Facilities</td>
<td>Hotels/Motels</td>
</tr>
<tr>
<td>Hospitals/Nursing Homes</td>
<td>Supermarkets/Department Stores</td>
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<tr>
<td>Cafeterias</td>
<td>Bars/Taverns</td>
</tr>
<tr>
<td>Catering</td>
<td>Kiosks</td>
</tr>
<tr>
<td>Correctional Facilities</td>
<td>Country Clubs/Resorts</td>
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</tbody>
</table>

*Table 2: Commercial Food Service Segments*
can be used to estimate the energy savings by replacing a standard efficiency with a new advanced gas griddle. Energy cost savings will typically range from $100 - $500 per year per 3-ft of griddle, based on the application and usage. More accurate estimates of savings can be determined using the following equations.

**Standard Savings Calculation**

The following equation can be used for estimating the annual energy required to operate a standard or high efficiency gas griddle. The energy savings will be the difference between annual energy requirements for the griddles being analyzed. The average rate of energy use for each category is available based on test data from applying the ASTM Standard Test Method for Performance of Griddles at the Food Service Technology Center (FSTC). Remember, this energy use rate will vary with appliance usage (e.g., quantity of food cooked, number of preheats, etc.) for any given operation.

\[
\text{therm savings} = \frac{\text{APECR} \times \text{daily}_\text{hrs} \times \text{annual}_\text{days}}{\text{100kBtu} / \text{therm}}
\]

where

\[
\text{APECR} = \text{Average Production Energy Consumption Rate (kBtu/hr)}
\]

\[
\text{daily}_\text{hrs} = \text{hours of operation per day}
\]

\[
\text{annual}_\text{days} = \text{days of operation per year}
\]

**Performance Measurements**

The work of the griddle can be described as bringing the cooking surface from room temperature up to cooking temperature (preheating), holding the plate at cooking temperature until cooking begins (idling), and restoring heat to the plate when food is cooked (recovery). An ASTM standard test method for griddles developed at PG&E’s FSTC allows manufacturers and users to gauge griddles’ production directly, and to evaluate griddle energy performance as well. As test data on griddles has become available, it is apparent that certain technologies and designs increase performance and reduce energy consumption.

The standard test method developed at the FSTC quantifies energy input rate, preheat energy and time, idle energy rate, pilot energy rate, cooking energy rate and efficiency, cooking surface temperature recovery time and production capacity. Other factors that affect the actual performance of a griddle include ease of cleaning and quality of construction.

**Cost and Service Life**

**Factors That Influence Service Life and First Cost**

First cost is driven by construction, features, and fuel source. High-efficiency burners are typically packaged with other features, such as all stainless steel construction and freestanding tables. Standard gas griddles typically list for $1200 to $3500, while high-efficiency gas griddles (infrared
burners, etc.) list for $3000 to $4500. Prices also will vary with the size of the griddle.

First cost information can be obtained from contacting the manufacturers and trade association listed in the Major Manufacturer section of this document. Typically manufacturers will quote list prices. Actual consumer prices can be significantly lower than list prices.

It is difficult to predict the life of a griddle. Life span is directly related to how well the griddle is maintained and how heavily it is used. However, life spans of 7 to 15 years are common in commercial kitchens.

Laws, Codes, and Regulations

Ventilation

Griddles, like other grease producing commercial food service appliances, require dedicated exhaust ventilation in accordance with national and local mechanical and fire codes. The new International Mechanical Code (IMC) classifies griddles as “medium temperature” and requires their installation below a Type I hood, suitable for cooking appliances that produce grease vapors or smoke. Hoods listed in accordance with UL 710 shall be installed in accordance with the manufacturer’s installation instructions. The exhaust hood shall be designed to confine cooking vapors and residues within the hood.

Fire Protection

An approved automatic fire-extinguishing system shall be provided for the protection of griddles. Protection shall also be provided for the exhaust hood and ductwork ventilating the griddle in accordance with NFPA 96.

Definitions of Key Terms

- **Atmospheric Burners**: Atmospheric burners have a small restriction called an orifice. Gas flows through the orifice and into the burner. Air is drawn into the burner to be mixed with the gas. The gas-air mixture leaves the burner ports and where it is ignited. An example of a typical atmospheric burner is the “Bunsen” burners used in the chemical department labs.

- **Average Production Energy Consumption 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. It is reported in kBtu/h.

\[
\text{Average Production Energy Consumption Rate} = \frac{\text{Production Energy Consumption}}{\text{Operating Time}}
\]

- **Cooking Energy Efficiency**: The ratio of energy added to the food and total energy supplied to the appliance during cooking:
The ASTM standard test method defines cooking rates and efficiencies for heavy-load, medium-load and light-load conditions.

- **Cooking Efficiency**: The rate at which a griddle consumes energy while it cooks a load of food. It is reported in kBtu/h.

- **Efficiency**: See cooking energy efficiency.

- **Energy Input Rate**: The maximum rate at which the griddle draws energy, expressed in kBtu/h. Energy input rate is an important factor in production capacity.

- **Idle**: See idle energy consumption.

- **Idle Energy Consumption (Idle Energy Use)**: The amount of energy consumed by an appliance operating under an idle condition over the duration of an idle or “standby” period. It is reported as kBtu.

- **Idle Energy Rate**: The rate at which a griddle uses energy to maintain the cooking surface at the desired cooking temperature (i.e., 375°F). Monitoring the usage of griddles in commercial kitchens has demonstrated that griddles spend a significant proportion of their appliance on time in idle mode and that the rate of idle energy consumption has a significant impact on total daily energy consumption.

- **Infrared Burners**: The infrared burners are constructed around porous ceramic plates or metal screens. The plates make up the burner head and combustion takes place on the surface at temperature up to 1800°F. As much as 50 percent of the energy in the gas is converted to infrared heat (radiant heat).

- **Preheat Energy**: The energy required to raise the griddle plate from room temperature to cooking temperature.

- **Preheat Time**: The time it takes to raise the griddle plate (cooking surface) from room temperature to cooking temperature. Griddles are usually maintained in a “ready-to-cook” mode during the day, so preheat time may not be important to the operator.

- **Production Capacity (Productivity, Throughput)**: The amount of food that can be cooked on a griddle in a given time. For single-sided griddles, this figure expressed as the number of pounds of hamburgers that can be cooked per hour. Production capacity is determined by the cook time and the recovery time of the griddle.

- **Productivity**: See Production capacity.

- **Rated Energy Input**: See energy input rate.

- **Recovery Time**: The time it takes a griddle to come back up to cooking temperature after the food is removed.
References to More Information


Major Manufacturers

(includes manufacturers who have had griddles tested at the FSTC)

Keating of Chicago, Inc.
715 South 25th Avenue
Bellwood, IL 60104
Tel (708) 544-6500
Tel (800) KEATING
Fax (708) 544-6505

Lang Manufacturing Company
9040 Willows Road
Redmond, WA 98073
Tel (206) 885-4045
Fax (206) 882-2373

Vulcan Hart
2006 North Western Parkway
Louisville, KY 40203
Tel (502) 778-2791
Fax (502) 775-8374

Wolf Range Company
19600 South Alameda Street
Compton, CA 90224
Tel (310) 637-3737
Tel (800) 366-WOLF
Fax (310) 637-7931

Information on this technology can also be found by contacting relevant trade organizations, such as the AGALResearch, the Gas Research Institute (GRI) and the Gas Appliance Manufacturers’ Association (GAMA).