

5 Range Tops

Introduction



*Figure 5-1.
Six-burner range top
with range oven.*

It can be said that the commercial range top is the most widely used piece of commercial cooking equipment. In addition to being widely used, the range top also is one of the most versatile cooking appliances, lending itself to numerous burner (element) configurations. Ranges are available with either gas or electric fuel sources, although gas dominates the market. Typically, a range-top configuration consists of six open gas burners with a standard oven incorporated underneath (see Figure 5-1). Though the commercial range top is similar to the residential stove, the major difference is durability; a food service range must withstand constant use and abuse while preparing tens or hundreds of meals a day.

The top section of the range is referred to as the “range top” and consists of burners or elements, which are used for cooking with pots and pans. The oven that is built into a range is called a “range oven”. Range ovens are most often standard ovens sized to fit under the range top, though a growing number of manufacturers offer convection range ovens. Ovens are discussed in detail in Section 7 of this report. Range-top configurations also may include griddles and broilers; these appliances are detailed in Section 3 and 4, respectively.

The configuration of a range is flexible by definition. The space underneath a range top that is usually devoted to a range oven may instead house a refrigerated cabinet or storage space for pots and pans. Above and behind the range top is the backshelf, which can accommodate an overfired salamander- or cheesemelter-type broiler. Smaller ranges may include a narrow griddle and/or charbroiler on either side of the range top.

Ranges are often divided into three categories depending on their intended use: heavy-duty or hotel ranges, medium duty or restaurant ranges, and specialty ranges such as stockpot and taco ranges. Heavy-duty ranges are built for continuous use in high-volume operations such as large restaurants, hospitals, and schools. They feature high-energy inputs and sturdy construction,

Range Tops

with range tops built to support the weight of large stockpots and enough power to heat such a vessel quickly. Restaurant ranges are more suited to a smaller operation, such as a lunch counter or smaller restaurant. Medium-duty ranges, although substantially built, are not as well suited for heavy use or abuse, and often have lower energy inputs (e.g., range top burners of 15-20 kBtu/h instead of a hotel range's 20-30 kBtu/h).

Induction range tops use electromagnetic energy to heat cookware made of magnetic material (steel, iron, nickel or various alloys). When the unit is turned on, the coils produce a high frequency alternating magnetic field, which ultimately flows through the cookware. Molecules in the cookware move back and forth rapidly, causing the cookware to become hot and cook the food.



Figure 5-2.
Stock pot range.

Photo: Vulcan Hart

Specialty ranges are built to perform a single function, as the name implies. Stockpot ranges consist of one or two high-input open burners with a very heavy-duty cast iron grate and are intended to cook large quantities of food in one cooking vessel. Chinese ranges are designed for wok cooking and are described in Section 6. An example of a specialty range is presented in Figure 5-2.

Range tops vary with fuel source and heating technology. Both gas burners and electric elements can be built into restaurant range tops, although gas is by far the most common. In hotel range tops, gas is almost universal.

Two or more range tops joined side-by-side is called a battery, often with matching trim, countertop sections and possibly a front-mounted gas manifold; such a range battery may stretch the length of a kitchen wall.

Cooking Processes

All range tops provide heat to a pot or pan from below. The method of heat delivery to the pot may vary, but the cooking process is always a function of the heat being delivered from the bottom of the pot/pan. One way in which this cooking process may be affected is through the heated area, or size of the heating pattern. Some range-top heating strategies provide uniform heat over a larger area, while others concentrate it more in one spot. This becomes a significant performance factor if the range top is used in a process such as cooking pancakes, where surface uniformity is important; however, the

Range Tops

choice of pan construction and materials can be used to mitigate unevenness in the heating source.

Controls

Range tops are generally not amenable to timers or cooking computers, and most range top cooking demands the attention of the operator. Controls on the range top are typically very simple. There is most often an infinite-control knob to regulate the input of each burner or element. The controls are calibrated in terms of the percentage of input, as the burner does not generally sense the temperature of the pot.

An exception to this rule is the induction ranges top, which has a temperature-limiting switch to guard against the pot-melting temperatures that this type of unit can produce. In addition, induction range tops will often have a microprocessor for temperature control. Just beneath the glass cook top is a tiny temperature sensor that connects to the microprocessor. When the temperature control is set to a particular temperature, the microprocessor monitors the temperature and cycles the induction hob on and off to maintain the desired temperature.

Heating Technologies

Gas burners and electric elements can be described as "open" or "closed". The most common type of range top uses open burners, applying flame directly to the bottom of the pot. Open tops generally offer fast heat-up, but can have slow cleanup, as spills can fall directly onto the burner or below. Cleanup may mean moving or removing parts of the range top to reach the mess. A closed burner or element seals the heat source under a ceramic, glass or metal cover, presenting a smooth surface to the bottom of the cooking vessel. This makes it easy to slide pots and pans on and off of the hot spots, and also eases cleanup.

Each heating technology described here comprises a different type of burner or element. Manufacturers commonly allow the user to specify a combination of burner or element configurations that will best suit their specific needs.

Open Burners and Discrete Elements

Open Gas Burners. Open gas burners remain the burner-of choice for most operators. They are inherently sturdy, inexpensive, and they respond instantly when the burner is turned on and adjusted. The visible flame provides direct feedback on the heat to the pan, enhancing the operator's control, and can ignite spattered grease to "flash" flame inside the pan during display cooking.



Figure 5-3.
Ring burner.

Photo: Fisher-Nickel, inc.

The gas burner has two designs. The first is a hollow ring of cast iron or steel with holes that jet gas upwards towards the cooking vessel (Figure 5-3). A newer but similar design is the star burner, which has arms radiating from a central hub spreading its flame more evenly over the pot bottom (Figure 5-4). Each burner design has the gas mixed with primary air at an air shutter on the manifold. Secondary air provides most of the oxygen for combustion, combining with the gas as it jets from the burner. The flame is controlled with a gas valve mounted on the front of the range.

The burner is set into the surface of the range top and covered by a metal grate, which supports the cooking vessel. Grates are designed so that pots can be slid easily from burner to burner, and are stable in any position. Normally with this grate design, a spill tray will be underneath the burner to catch falling particles and/or drips. The grates may be removable, and on some range tops the burner heads lift off for easy cleaning.

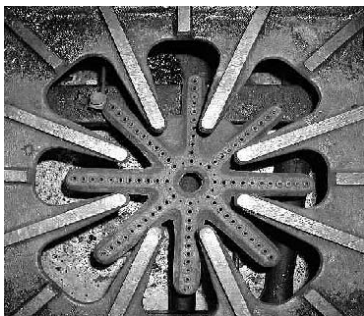


Figure 5-4.
Star burner.

Photo: Fisher-Nickel, inc.

The typical input rating for an open gas burner is 20 to 25 kBtu/h, with manufacturers offering 30 kBtu/h burners as an option. Until recently, the higher-input burners only were used in the most demanding production applications. However, they now are becoming the industry standard for heavy-duty ranges. Studies at the FSTC indicate that, under normal operating conditions, these higher input burners do not use significantly more energy to cook as one might intuitively think. Although the gas input is higher, the cook time is correspondingly shorter.¹ However, the net effect of these more powerful burners could be an increase in energy consumption if the burners were left on between cooking events as sometimes happens in high profile display kitchens or on sauté lines.

Range Tops



Figure 5-5.
Electric speed coil.
Photo: Clarkenergy.com

Electric Speed Coils. Sheathed electric coils, wound into a spiral element, are used on light- and medium-duty restaurant ranges. See Figure 5-5. These elements also are known as “speed coils.” Analogous to the elements on a residential electric range, they provide fast heat and response. They are relatively fragile though and not recommended for use with heavy stockpots.

Electric French Plates. (Also called round plates.) In a French plate element, the open electric coil is covered with a solid metal disk. They are generally 6-10 inches (150-250 mm) in diameter, and protrude ¼ to ½ inch (6 to 12 mm) above the range top. By concentrating heat under the pot, they pre-heat faster than an electric hot top, and are more durable and easier to clean than an electric speed coil. Figure 5-6 shows an electric range with French plates.

Closed Burners and Elements



Figure 5-6.
French plate range top.
Photo: Garland Range.

Gas Hot Tops. The hot top is a flat metal plate made of cast iron or steel, heated from underneath by atmospheric gas burners. The bottom of the plate may be flat, textured, or finned to distribute heat evenly. The surface of the hot top reaches temperatures of 800°F-1000°F (425°C to 540°C) at the maximum input. Some hot tops are constructed so that there is a temperature gradient from front to back, allowing different styles of cooking on the same section. The hot-top section is typically 24 inches (600 mm) deep and 12-18 inches (300-450 mm) wide. A range top may consist of several sections, each having its own burner and control knob.

Hot tops allow the entire surface of the range top to be used, instead of only the space directly over the burners. This allows an operation that prepares many small orders at once to fit more pans on the range top. Pots slide across the flat surface more easily than across the grids on an open-burner range top. This facilitates moving items such as soups or stews from a front hot-top section that is set at a high temperature (i.e., for boiling) to an alternate section that is set at a lower temperature (i.e., for continued simmering or holding). However, the hot top is slow to heat: it may take 30 to 60 minutes before the plate reaches its maximum temperature setting. Similarly, it is slow to respond to changes in the control setting.

Range Tops

Hot tops are typically preheated in the morning and left on at maximum input throughout the day. They consume energy at a high rate, and radiate more heat into the kitchen than any other type of range top. The energy input rates are from 20-40 kBtu/h per section.

One alternative to the high energy consumption of the hot top is the open grate top. This range top has a continuous flat surface like a hot top but surface is comprised of a grate instead of a solid plate. This configuration reduces the heat-up time of the top and allows the operator to see the burners and control them more accurately. Ultimately, the operator has the work surface associated with a hot top combined with the speed and flexibility of an open burner range top. This style of level-surface grate is becoming a standard feature on most heavy-duty, open-burner ranges.

Gas Radiant Hot Top. (Also called French top or pot ranges) This is a specialized hot top in which the metal plate is inset with removable concentric rings. The rings may be removed to expose more of the cooking vessel to the direct flame of the burners. This style of hot top uses very high-powered burners with inputs up to 45 kBtu/h. In this case, the controls on the range top allow the operator to adjust input to each ring separately.

Electric Hot Tops. Electric hot tops are not common. They are identical in construction and detail to the gas hot top, except the heat source is an electric element clamped to the bottom of the plate. Electric hot tops are rated from 5 kW to 7.5 kW per section.

Induction Cook Tops. The electric induction range is significantly different from other types of ranges. An induction cooktop by and large consists of a single hob (burner), but two-hob units are available, with the exception of Europe and Asia, where six-hob units are offered (note that a U.S. manufacturer had a six-hob unit was on display at the 2002 National Restaurant Association show in Chicago). The range surface is a smooth and continuous ceramic glass plate. Because it is not directly heated during operation, the surface remains relatively cool, gaining residual heat from the cooking container. These units offer precise temperature control and are more efficient because the cookware is heated directly, without the need to preheat heat the cooking surface.

A recent addition to the induction range family is the induction wok. These units offer high production capacity in a small package and without the need to water-cool the surrounding surface, as with traditional gas woks. They do employ a different control mechanism from traditional woks and may not be a direct replacement for gas-fired Chinese ranges in traditional Asian cooking. Induction units are by far the most energy efficient type of range available.

Advanced Technologies

Technologies developed for commercial use have focused on improving gas burner efficiencies, and on designing easy-to-clean closed range tops for both gas and electric ranges.

Power Burners

Power burners premix gas and air in stoichiometric proportions for efficient combustion. Because no secondary air needs to be drawn into the flame at the burner head, the grate can be constructed to form an almost airtight chamber beneath the pot. This eliminates the rapid convection that washes much of a conventional burner's heat up and around the cooking vessel. Thus, more of the hot-combustion products transfer heat to the bottom of the vessel. The intense heat of the power burner presented its own obstacle. The initial commercial release was halted because users complained about pots warping on the new burners, as a result of underestimating the cooking speed and allowing pots to boil dry.

Testing by the American Gas Association Laboratories (AGAL) showed a power burner to be 36% faster and use 34% less energy than a conventional 20 kBtu/h star burner.² Although the initial cost of a power-burner is higher than a standard burner, AGAL estimated that energy savings would compensate for the cost difference in less than two years.

Sealed Combustion

The Canadian Gas Research Institute (CGRI) developed a prototype range top, which featured standard gas burners under a glass ceramic surface.³ Each

burner is surrounded by a ceramic cup, which is heated to over 1200°F (650°C) during operation. Heat is supplied to the cooking vessel by conduction through the glass ceramic surface and by radiation from the burner flame and ceramic enclosure. An over-limit switch shuts the burners off if the temperature of the ceramic glass top rises outside the operating range.

The burners are completely enclosed, and all combustion products are vented outdoors. This closed-burner design has the appeal of easy cleanup, a visible heat source and according to Gas Technology Institute (GTI), a higher efficiency than standard gas open burners.

The current sealed-combustion prototype is for residential applications. The unit's easy cleanup, speed and lower heat gain to the kitchen also would be valuable in a food-service setting.

Gaz de France, as part of their strategy to help the foodservice industry, and in concert with commercial cooking equipment manufacturers, has introduced a patented Vitrogaz ceramic hot plate. It features a smooth, flat, easy to clean cooking surface and is powered with two high-performance, 27 kBtu/h radiant burners. It can be used with an open flame or as a solid-top plate. Plate temperatures are adjustable between 140°F and 1112°F (60°C and 600°C).⁴

Infrared Burners

Infrared burners force gas and air through a ceramic burner. The surface of the burner, where combustion takes place, is perforated with thousands of pores. During operation the ceramic burner face reaches temperatures above 1600°F (870°C). Infrared burners are more efficient than the standard gas burner, but they have not yet been successfully applied to the commercial food service range top.

A setback lies in spilled food product clogging the burner holes. A solution is the infrared jet-impingement burner, which uses an infrared ceramic burner beneath a perforated glass-ceramic plate. The glowing ceramic burner transmits radiant heat to the cooking container, and the combustion products are propelled through the holes in the ceramic glass shield to impinge on the bottom of the pot. The shield prevents spillage from dripping onto the burner,

and what does flow through the holes is incinerated. The developer, Tecogen Inc., rates the ease of cleaning these burners as “somewhat better than conventional burners.” The developer reports a water boil efficiency of 66% as opposed to 40% for a regular burner.⁵

Halogen Range Tops

Halogen range tops share two of the major advantages of the induction range top—fast response to controls and a sealed cooking surface. In addition, the halogen elements glow red in proportion to the energy input, providing visual feedback of heat intensity. Unlike induction range tops, the cooking surface does heat up, and power does not instantly modulate to idle when the pot is removed.

The heat source for this range top is a set of halogen lamps beneath a glass ceramic cooktop. Pots and pans rest directly on the ceramic and are heated by radiant energy from the lamps. An over-limit switch monitors the glass ceramic material, cutting off the power when the temperature of the cooktop exceeds safe limits. The efficiency of a residential halogen cooktop has been reported at 52%-58%.⁶ Currently this technology is not available in commercial range units.

Automatic Burner Shut Off and Re-Ignition.

In catering kitchens it is often more practical to leave open-flame burners lit when not being used, rather than turning the gas off and re-lighting it each time when needed. Gaz de France, along with Madec-Mater Company, has patented the Top-Flam—an automatic shut-off and re-ignition device that is triggered by cookware detection. They proclaim energy savings around 50%.⁴

A similar burner control system was developed in the United States by Leonard Grech and documented by the U. S. Department of Energy’s Office of Industrial Technology. This system uses a small, vertically mounted, spring-loaded piston that controls a gas valve. When a pot is placed on the burner,

the piston is depressed and the gas valve is opened. When the pot is removed, the piston returns to its original position and the burner is turned off.

Range Top Performance

Performance Evaluation Criteria

ASTM Standard F 1521–96 *Standard Test Methods for Performance of Range Tops*⁷, developed at the Food Service Technology Center, provides a means to compare performance and energy use of range tops⁸.

The test method covers the performance of gas and electric range tops, including discreet burners and elements, as well as hot tops. The application of the test method provides results for maximum rate of energy input, temperature uniformity of heating surface, cooking-energy efficiency and production capacity.

Measuring the temperature uniformity of a steel plate emulating the bottom of a frying pan can simulate the heat-transfer characteristics of a cooking unit. Applying this test procedure gives the temperature at several points across the area of a pot's bottom, indicating hot or cold spots.

Production capacity is the amount of food that a burner or element can cook in a given time, expressed as gallons of water that can be raised from 70°F to 200°F (21°C-93°C) in one hour. This provides an indication of the “speed” of a burner.

Maximum rate of energy input is a rough index of the “power” of a range top. The test method reports the total energy input rate for all the burners on a range top. It is more common in catalogs to see a rating for individual burners or elements. For a given type of burner or element, a higher rate of energy input generally indicates that the burner can supply more heat to the pan. This is only true when comparing similar burners; a high-efficiency burner can use less energy, but perform more work than a low-efficiency burner (i.e., cook the same quantity of food in less time).

The American National Standard Institute (ANSI) for Gas Food Service Equipment Ranges and Unit Broilers (Z83.11 –1989) section 2.12⁹ also details test criteria and methods for evaluating the efficiency of an open gas range top. ANSI's test requirement is similar to ASTM with some minor dif-

Range Tops

ferences. Table 5-1 compares the test criteria between ASTM F1521-96 and ANSI Z83.11 – 1989.

Table 5-1. Comparison of ASTM and ANSI Range Top Efficiency Tests.

	ASTM F1521-96	ANSI Z83.11			Proposed Revisions to ASTM F1521-96 ^a
Stabilization Time (min.)	30		30		30
Temperature Rise (°F)	130°F		130°F		130°F
Control Setting	Maximum		Maximum		Maximum
Pot Diameter (inches)	12	<15,000 Btu 9.5"	15,000 to 25,999 Btu 13"	>26,000 Btu 16"	13"
Water Weight (lbs)	20	N/A (10) ^b	N/A (20) ^b	N/A (29) ^b	20
Water Depth (inches)	N/A (5) ^c		4		N/A (4) ^c

^a Proposed change from 12-inch stockpot to 13-inch stockpot has been accepted by the F26 ASTM technical committee.

^b Measured water weight with respect to 4-inches of water depth. Note: Water weight is not specified in ANSI Z83.11

^c Measured water depth with respect to 20 pounds of water in the specified pot. Note: The ASTM test method specifies water weight instead of water depth since weight can be determined more accurately.

Table 5-1 shows that specified stabilization times, temperature rise, and power settings are identical for the two methods. The differences are the diameter of the pots and the weight and depth of water. Based on the outcome of investigating these latter differences, researchers at the Food Service Technology Center will initiate a proposal to revise ASTM F1521-96 to be consistent with ANSI Z83.11. The proposed changes are as follows:

1. Change the ASTM specification from a 12-inch diameter pot to a 13-inch diameter pot to match ANSI's requirement for a range top with an energy input rate between 15,000 – 25,999 Btu/h (Update: proposed change has been accepted by F26 ASTM Technical Committee; revision will be made to the current test method).

2. Adopt 13-inch diameter pot test for all burner types and input rates on standard range tops.
3. Add an extra-heavy load test using a 16-inch diameter pot.
4. Water weight will remain as the test criterion in the ASTM test, since weight is an accurate method of measuring water, and this value needs to be precise for the efficiency calculation.

Benchmark Energy Efficiency

Cooking-energy efficiency, as defined by the ASTM Standard Test Method for Performance of Range Tops,⁷ is the ratio of the amount of energy going into the food versus the amount of energy supplied to the burner:

$$CookingEfficiency = \frac{E_{Food}}{E_{Appliance}} \times 100\%$$

Energy efficiency is determined by heating water from 70 to 200°F (21 to 93°C) at the full-energy input rate. Using FSTC data generated by the ASTM method⁷, along with data from the Minnesota study¹⁰ and range top development and testing by AGAL,^{11,12} benchmark energy efficiencies are presented in Table 5-2.

The efficiency of gas range tops has received attention from both the manufacturer and the end user.¹³ Research organizations such as the GTI have been instrumental in attempting to develop and bring high-efficiency gas models to the US market. Standard electric range tops, at roughly 65-75%, are already quite efficient. With the introduction of induction technology, electric range top efficiencies are approaching 85%.

Table 5-2. *Range Top Energy Efficiency.*^a

High Efficiency Gas (%)	Standard Gas (%)	Electric. (%)
30 - 40	25 - 30	65 - 85

^a Energy efficiency numbers for range tops are best estimates based on FSTC test data from applying ASTM Standard Test Methods to four different range tops^{1,14-16}, on preliminary results from revising the existing ASTM Standard and applying it to three electric induction units¹⁸⁻¹⁹ and on data from both the Minnesota Study¹⁰ and AGAL testing^{9,11,12}.

Range Tops

Range Top Energy Consumption

Projected energy consumption for gas and electric range tops are presented in Tables 5-3 and 5-4. The energy consumption rates for the range tops and range ovens are based on in-kitchen monitoring of gas and electric ranges, outfitted with either a standard or a convection oven, in the Pacific Gas and Electric Company production-test kitchen.²⁰⁻²⁶ The duty cycle was calculated by dividing the daily energy consumption rate by the appliance median energy input rate. Typical operating hours were obtained from in-kitchen energy-use monitoring experiences and observations as well as from the PREP study²⁷ and a proprietary end-use monitoring report. Projected annual energy consumption was determined by assuming a 6-day per week, 52-week per year operation.

Table 5-3. Projected Energy Consumption for Gas Ranges.

	Nominal Size	Rated Energy Input (kBtu/h)	Duty Cycle (%)	Avg. Energy Consumption (kBtu/h) ^a	Typical Operating Hours (h/d) ^b	Annual Energy Consumption (kBtu) ^c
Range Top (Median)	6 Burners	120 - 210 165	20	32	12	120,000
Range Oven (Median)		35 - 45 40	40	16	8	39,900
Total Range		205		48		160,000

^a Average energy consumption rates are based on monitoring five gas ranges in a real-world production kitchen.²⁰⁻²⁴

^b Operating hours or appliance "on time" is the total period of time that an appliance is operated from the time it is turned "on" to the time it is turned "off".

^c The annual energy consumption calculation is based on the average energy consumption rate x the typical operating hours x 6 days per week x 52 weeks per year.

Range Tops

Table 5-4. Projected Energy Consumption for Electric Ranges.

	Nominal Size	Rated Energy Input (kW)	Duty Cycle (%)	Avg. Energy Consumption (kW) ^a	Typical Operating Hours (h/d) ^b	Annual Energy Consumption (kWh) ^c (kBtu) ^d	
Range Top	6 elements	12					
(Median)		12	25	3	12	11,200	38,300
Range Oven		8					
(Median)		8	25	2	8	4,990	17,000
Total Range				5		16,200	55,300

^aAverage energy consumption rates are based on monitoring two electric ranges in a real-world production kitchen.^{25,26}

^bOperating hours or appliance "on time" is the total period of time that an appliance is operated from the time it is turned "on" to the time it is turned "off".

^cThe annual energy consumption calculation is based on the average energy consumption rate x the typical operating hours x 6 days per week x 52 weeks per year.

^dConversion Factor: 1 kW = 3.413 kBtu/h.

Ventilation Requirements

Ranges are classified as medium duty from the perspective of exhaust ventilation. For a sidewall canopy hood, the design ventilation rate for ranges would range from 200- 300 cfm (100-150 L/s) per linear foot of wall canopy hood.

Research and Development

Gas range tops have historically had several advantages over electric range tops. Gas is faster with no wait for preheating. Gas is more responsive: an adjustment to the controls changes the heat to the pan bottom immediately. Gas is more durable: heavy-duty construction and long life are hallmarks of gas-range construction. Gas is inexpensive: even though a gas range operates at a lower efficiency, the operating cost is often half that of an electric range top.

In turn, electric range tops have had the advantage of high efficiency and are easier to clean when closed burners are used. The induction range top combines these features with a serious challenge to the superiority of gas in speed and responsiveness. It is an easy to clean, fast heat source with a discrete-load cooking efficiency of over 80%, and it adds little heat to the kitchen. In real world cooking, induction saves even more energy by dropping to, effec-

tively, zero energy input the instant a pot is removed from the element, and coming back to full input when the pot is replaced. Although induction range tops have not yet been proven by years of use in the food service kitchen and the durability of the electronics and ceramic cooktop remains to be seen, they represent a credible challenge in a category that has historically been dominated by gas appliances.

In response, the gas industry initiated an advanced range top development project with the goal of modernizing the standard gas range and reinforcing its market dominance. Drawing on research performed by Arthur D. Little, the Food Service Technology Center, and Gaz de' France, and with the additional support of Enbridge Gas Distribution, the Southern California Gas Company, and the Gas Technology Institute, the Canadian Gas Research Institute (CGRI) published an Assessment of Technical Strategies for an Advanced Commercial Gas-Fired Rangetop²⁸. This report was further refined into a Summary Report on an Advanced Rangetop for Presentation to End-Users, Rangetop Manufacturers and Government Agencies²⁹. The goals of this research were to create a gas range with:²⁹

- Improved cooking efficiency/ productivity,
- Reduced energy consumption,
- Reduced maintenance/easy cleanability, and
- Improved food quality/consistency.

The assessment presented three advanced range top options²⁹:

1. State-of-the-Art Rangetop with Atmospheric Burner – incorporating open top atmospheric burners with enhanced cleanability and boil booster and simmer capability.
2. Rangetop with Enhanced Output / Heat Transfer – incorporating power burner technologies and/or atmospheric pressurized burner concepts.
3. Smooth Top Rangetop – features a closed smooth top with high efficiency radiant burners.

All three of these options included improved burner technologies, incorporation of an energy saving device/ burner control system, and elimination of standing pilots.

While there are technical issues that must be overcome before the advanced range is a market reality, the report's conclusion was that it was possible to create an improved range top that met the expectations of end-users and industry alike and that the payback would range from one to four years.²⁹

With this in hand, the gas industry (with GTI's lead) has continued work on the advanced gas range, focusing on developing commercial grade ceramic tops and sealed elements, and higher efficiency burners.

Future research should continue along these paths, with emphasis on the following:

- Further development of the sealed combustion range top for commercial food service. This technology would allow ventilation at lower airflows and reduce kitchen heat gain, as well as provide a desirable closed cook-top.
- Development of a hot top using infrared burners. This technology is already applied to analogous appliances such as griddles, and would reduce energy costs for gas hot tops.
- Development of higher efficiency, low-first-cost open gas burners.
- Investigate the feasibility of the cooking vessel sensor. Open gas burners should take advantage of their traditional strength—instant heat—by turning off when the pot is removed, and then back on when it is replaced. This can increase the cost advantage of gas, and provides a response to one of the strong features of the induction range top: zero idle energy usage. This will also reduce heat gain to the kitchen.
- Development of cooking vessel temperature feedback. An over limit switch to cut input when a pot has heated to the point of warping would allow further marketing of the power burner. If sensitive enough, such a device could begin to automate cooking. For example, a stockpot could be brought to a boil and then held at simmer.

Range Tops

- Inclusion of the NAFEM Online Kitchen protocol compliant technology into the range control system.

Industry Market Focus

Induction rangetops are rapidly gaining popularity within the commercial food service world. With recent improvements to the induction electronics and significant reductions in first cost, the induction rangetop will inevitably begin to impact the market share of the traditional gas range. The gas industry must continue to evolve the design and functionality of the gas range top if this appliance is to retain its current market dominance.

From a conservation perspective, gas utilities should promote the use of open burner or open-grate hot tops over full-hot tops. This can significantly reduce operating costs of ranges and heat gain to the kitchen.

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