ENERGY STAR® Program Requirements
Product Specification for Commercial Ovens

Eligibility Criteria
Draft 2, Version 3.0

Following is the Draft 2, Version 3.0 product specification for ENERGY STAR certified commercial ovens. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1) Definitions: Below are the definitions of the relevant terms in this document.

A. Oven: A chamber designed for heating, roasting, or baking food by conduction, convection, radiation, and/or electromagnetic energy.¹

B. Combination Oven: A device that combines the function of hot air convection (oven mode), steam heating (steam mode), and a combination of both (combination mode), which includes high and low temperature steaming, baking, roasting, rethermalizing, and proofing of various food products. In general, the term combination oven is used to describe this type of equipment, which is self-contained.² The combination oven is also referred to as a combination oven/steamer, combi, or combo.

a. Half-Size Combination Oven: A combination oven capable of accommodating a single 12.7 x 20.8 x 2.5-inch steam table pan per rack position, loaded from front-to-back or lengthwise.

b. Full-Size Combination Oven: A combination oven capable of accommodating two 12.7 x 20.8 x 2.5-inch steam table pans per rack position, loaded from front-to-back or lengthwise.

c. 2/3-Size Combination Oven: A combination oven capable of accommodating a single 13.8 x 12.7 x 2.5-inch steam table pan per rack position, loaded from front-to-back or lengthwise. The 2/3-Size Combination oven may also be referred to as a mini-size combination oven.

C. Convection Oven: A general-purpose oven that cooks food by forcing hot dry air over the food product's surface. The rapidly moving hot air strips away the cooler air layer next to the food and enables the food to absorb the heat energy. For this specification, convection ovens do not include ovens that can heat the cooking cavity with saturated or superheated steam. However, this oven type may have moisture injection capabilities (e.g., baking ovens and moisture-assist ovens). Ovens that include a hold feature are eligible under this specification as long as convection is the only method used to cook the food fully.

a. Half-Size Convection Oven: A convection oven capable of accommodating half-size sheet pans measuring 18 x 13 x 1-inch.

b. Full-Size Convection Oven: A convection oven capable of accommodating standard full-size sheet pans measuring 18 x 26 x 1-inch.

D. Conventional or Standard Oven: An oven that cooks food primarily using the naturally occurring hot air currents to transfer heat over the food product's surface without the use of a fan or blower. The burner or elements heat the air within the oven cavity and the cavity walls, causing currents of hot air that transfer heat to the surface of the food. The hot air's buoyancy

carries it upward through cooler air, which then slowly sinks to the bottom of the oven as it cools off.

E. **Conveyor Oven**: An oven designed to carry food product on a moving belt into and through a heated chamber.

F. **Slow Cook-and-Hold Oven**: An oven designed specifically for low-temperature (e.g., less than 300°F) cooking, followed by a holding period at a specified temperature.

G. **Deck Oven**: An oven that cooks food product directly on the floor of a heated chamber. The bottom of each compartment is called a deck and heat is typically supplied by burners or elements located beneath the deck. The oven ceiling, floor, and walls are designed to absorb heat quickly and radiate that heat back slowly and evenly.

H. **Hearth Oven**: An oven designed with an open doorway and dome-shaped interior, usually composed of high-temperature refractory ceramic or concrete. Hearth ovens do not include ovens designed to use interior walls as cooking surfaces. **NOTE** — Hearth ovens are designed with an unrestricted open doorway due in part to potentially high operational temperatures. A closed grease-laden oven compartment may present a fire hazard when oven surface temperatures exceed 600 °F (316 °C), and an oven door is opened.³

I. **Microwave Oven**: An oven in which foods are heated and/or cooked when they absorb microwave energy (short electromagnetic waves) generated by a magnetron(s).⁴

J. **Rack Oven**: A high-capacity oven that offers the ability to produce steam internally and is fitted with a motor-driven mechanism for rotating multiple pans inserted into one or more removable or fixed pan racks within the oven cavity.

a. **Mini Rack Oven**: A stand-mounted rack oven designed with a load-in-place rack that cannot be removed. Mini rack ovens can accommodate up to 10 standard full-size sheet pans measuring 18 x 26 x 1-inch.

b. **Single Rack Oven**: A floor-model rack oven that can accommodate one removable single rack of standard sheet pans measuring 18 x 26 x 1-inch.

c. **Double Rack Oven**: A floor-model rack oven that can accommodate two removable single racks of standard sheet pans measuring 18 x 26 x 1-inch or one removable double-width rack.

d. **Quadruple Rack Oven**: A floor-model rack oven that can accommodate four removable single racks of standard sheet pans measuring 18 x 26 x 1-inch or two removable double-width racks.

K. **Range Oven**: An oven base for a commercial range top (i.e., burners, electric elements, or hobs). Range ovens may use either standard or convection technologies to cook food.

L. **Rapid Cook Oven**: An oven that utilizes one or more non-traditional heat transfer technologies to cook food product significantly faster than would be possible using conventional (e.g., convection, conduction, radiant) heat transfer technologies. Heat transfer technologies that may be employed include microwave, quartz halogen, and high-velocity or impingement convection.

M. **Rotisserie Oven**: An oven fitted with a mechanism to move or turn food past a fixed heat source while the food is slowly being cooked on all sides.

N. **Reel-type Oven (revolving tray oven)**: An oven with a motor-driven Ferris wheel device.⁵

³ NSF/ANSI 170-2019, "Glossary of Food Equipment Terminology."
⁴ NSF/ANSI 170-2019, "Glossary of Food Equipment Terminology."
⁵ NSF/ANSI 170-2019, "Glossary of Food Equipment Terminology."
**Preheat Values**

O. **Preheat Energy**: The amount of energy consumed by the convection, combination, or rack oven while preheating its cavity from ambient temperature to the specified thermostat set point. It is expressed in Btu or kWh.

P. **Preheat Time**: The time required for the oven cavity to preheat from ambient temperature to the specified thermostat set point. It is expressed in minutes (min).

*Note:* EPA is maintaining the addition of *Preheat Energy* and *Preheat Time* proposed in Draft 1. Stakeholders agreed that including the energy and time during the preheat sequence(s) provides customers with a more comprehensive energy profile, is already captured using the referenced ASTM test methods in Table 4 below, and should not be an additional burden on manufacturers. EPA uses these data to capture a more realistic energy consumption profile for annual energy savings and does not anticipate creating a criterion level at this time.

**Energy Efficiency Metrics**

Q. **Baking-Energy Efficiency**: Quantity of energy imparted to the specified load, expressed as a percentage of energy consumed by the oven during the baking event.

R. **Cooking-Energy Efficiency**: Quantity of energy imparted to the specified load, expressed as a percentage of energy consumed by the oven during the cooking event.

S. **Idle Energy Rate**: The rate of oven energy consumption while it is maintaining or holding at a stabilized operating condition or temperature. Also called standby energy rate.

T. **Total Idle Energy Rate**: The rate of oven energy consumption while it is maintaining or holding at a stabilized operating condition or temperature. Total idle energy rate includes gas and electric energy (primary and auxiliary). Also called total standby energy rate.

**Water Consumption**

U. **Average Water Consumption Rates**: The monitored water consumption of an oven during specified test conditions. These metrics shall include condensate cooling water, if applicable.

a. **Combination Oven Water Consumption Rate**: The water consumed during idle and heavy-load cooking periods in steam and convection mode, expressed as gallons per hour per steam pan (gal/hr/pan). Gallon per hour per pan shall be based on GN 1/1 steam table pans as defined in Section 1.B.a. and 1.B.b. for full and half-size combination ovens and GN 2/3 steam table pans as defined in Section 1.B.c. for 2/3-size combination ovens.

b. **Convection Oven Water Consumption Rate**: The water consumed during the moisture injection mode by an oven without a dedicated steam only mode. The highest moisture injection mode available shall be tested during the idle and cooking modes, expressed as gallons per hour per full-size or half-size sheet pan (gal/hr/pan), as defined in Section 1.C.a and 1.C.b., respectively.

c. **Rack Oven Water Consumption Rate**: The water consumed by an oven with a moisture (steam) injection mode, the highest moisture setting delivered per cycle is captured.

V. **Average Rack Oven Steam Injection Rate**: Water consumption during a period where the highest steam injection mode available is introduced into the baking cavity of a rack oven during a steam injection cycle, expressed as gallons per minute (gal/min).

W. **Average Combination Oven Condensate Temperature**: The condensed steam and cooling water mixture’s average temperature exiting the combination oven and directed to the drain during heavy-load cooking in steam and convection modes.
X. **Maximum Combination Oven Condensate Temperature:** The maximum temperature of the condensed steam and cooling water mixture exiting the combination oven and directed to the drain during heavy-load cooking in steam and convection modes.

**Note:** EPA is interested in saving water. To that end, EPA’s WaterSense® program labels water saving products. In cases where an ENERGY STAR product category also uses water, the two programs have agreed that ENERGY STAR will set water criteria in collaboration with WaterSense. Further, EPA wants to avoid tradeoffs that might not be good for the environment and requests comments from stakeholders on the possible tradeoffs of the proposed water consumption criteria. The programs are interested in further understanding water consumption rates for commercial ovens, especially during cooking and idle periods in steam and convection modes for combination ovens to help customers obtain a more complete water use profile. Therefore, the Agency proposes including new water consumption criteria during cooking periods in both steam and convection mode for combination ovens (see Section 3) and new water consumption reporting requirements for convection and rack ovens (see Section 4).

Water consumption definitions are updated to clarify relevant terms. For instance, the additional language in Section 1.U., “This metric shall include condensate cooling water, if applicable.”, clarifies that an oven deploying condensate cooling water is included in the water consumption rate metric.

Some convection and rack ovens include moisture (or steam) injection modes. Convection ovens or rack ovens with moisture injection modes shall be tested to the referenced ASTM F2861-20, *Standard Test Method for Enhanced Performance of Combination Oven in Various Modes* for convection ovens, or ASTM F2093-18, *Standard Test Method for Performance of Rack Ovens* for rack ovens. Convection oven water consumption rates shall be reported in gallons per hour per standard full or half-size sheet pan (gal/hr/pan). Rack oven water consumption shall be reported as the average steam injection rate, expressed in gallons per minute (gal/min) and is dependent on the steam injection cycle.

Stakeholders are encouraged to provide feedback on revised definitions and water consumption units.

**Certification Terms**

Y. **Product Family:** Individual models offered within a product line based on the same engineering design, including pan capacity, fuel type, and method of steam generation, as applicable. Acceptable differences within a product family for certification purposes include controls, door-opening orientation, and any aesthetic additions that have no impact on oven energy consumption in any operating mode. Double stacked ovens with two separate, individually operated ovens shall be listed as an additional model under the product family base model since these ovens are tested as a single cavity and therefore have identical performance values. All models within a product family shall be listed as an additional model.

**Note:** Historically, double stacked ovens were tested as a single cavity – i.e., they were not tested with both cavities operating and therefore have identical performance values to the single cavity base model. Some partners have listed double stacked (decker) ovens as part of the base model while other partners have not, and the additional text clarifies how double stacked ovens shall be reported: double stacked ovens will be considered an additional model under the base product family model, not a separate model.

All models within a product family should be listed in the additional model section in the Qualified Product List (QPL), and this clarification is included in 1.Y.

EPA encourages additional stakeholder feedback on these clarifications and the addition of double stacked ovens to the product family.

Z. **Pan Capacity:** The number of steam table pans the combination oven can accommodate as per the ASTM F1495-20 standard specification.

AA. **Single Rack:** Single racks shall accommodate 15 full-size sheet pans measuring 18 x 26 x 1-inch, at a 4-inch spacing between rack positions. Single racks accommodate 1 full-size sheet pan per
rack position.

BB. Double-Width Rack: Double racks shall accommodate 30 full-size sheet pans measuring 18 x 26 x 1-inch, at a 4-inch spacing between rack positions. Double racks accommodate 2 full-size sheet pan per rack position.

CC. Set-Back Idle Mode: A feature that includes automatic temperature reduction after extended periods of non-use. In addition, the feature may also incorporate the reduction or elimination of fan speed, lighting, and automatic rack rotation during periods of non-use.

2) Scope:

A. Included Products: Products that meet the definitions of a Commercial Oven and Convection Oven, Combination Oven, or Rack Oven as specified herein are eligible for ENERGY STAR certification, except products listed in Section 2.B. The following sub-types are eligible:

a. Full-size gas and half- and full-size electric convection ovens.

b. Half- and full-size gas combination ovens with a pan capacity ≥ 5 and ≤ 40.

c. Half- and full-size electric combination ovens with a pan capacity ≥ 3 and ≤ 40.

d. 2/3-size electric combination ovens with a pan capacity ≥ 3 and ≤ 5.

e. Single and double gas rack ovens.

To ensure only commercial ovens are certified under this specification, products shall be third-party certified to NSF/ANSI Standard 4, Commercial Cooking, Rethermalization, and Powered Hot Food Holding and Transport Equipment.

B. Excluded Products: This specification is intended for commercial food-grade ovens. Ovens designed for residential or laboratory applications cannot be certified for ENERGY STAR under this specification. The following oven types and sub-types are ineligible for ENERGY STAR:


b. Dual-fuel heat source combination ovens.

c. Hybrid ovens not listed in Section 2.A, above, such as those incorporating microwave settings in addition to convection.

d. Conventional or standard ovens; conveyor; slow cook-and-hold; deck; hearth; microwave; range; rapid cook; reel-type; and rotisserie.

e. Half- and full-size gas combination ovens with a pan capacity of < 5 or > 40.

f. Half- and full-size electric combination ovens with a pan capacity < 3 or > 40.

g. Mini and quadruple gas rack ovens.

h. Electric rack ovens.

i. 2/3-size electric combination ovens with a pan capacity >5.

Note: We appreciate that several stakeholders supported the combination oven scope expansion and agreed that these changes may result in high operational and emission savings.
3) Certification Criteria:

A. Convection Oven Cooking-Energy Efficiency and Idle Energy Rate Requirements:

| Table 1: Energy Efficiency and Water Consumption Rate Requirements for Convection Ovens |
|----------------------------------------|---------------------------------|---------------------------------|
| **Gas** | **Oven Capacity** | **Idle Rate, Btu/h** | **Cooking-Energy Efficiency, %** |
| Full-Size | ≤ 9,500 | ≥ 49 |
| Electric | **Oven Capacity** | **Idle Rate, kW** | **Cooking-Energy Efficiency, %** |
| Half-Size | ≤ 1.00 | ≥ 71 |
| Full-Size ≥ 5 Pans | ≤ 1.40 | ≥ 76 |
| Full-Size < 5 Pans | ≤ 1.00 |

**Water Consumption Rate: All Convection Ovens with Moisture Injection Mode**

<table>
<thead>
<tr>
<th>Mode</th>
<th><strong>Idle Period (gal/hr/pan)</strong></th>
<th><strong>Cooking Period (gal/hr/pan)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Injection Mode</td>
<td>Reporting Requirement</td>
<td>Reporting Requirement</td>
</tr>
</tbody>
</table>

Note: Pans = Standard full-size sheet pan capacity as defined in Section 1.C.b., above.

B. Combination Oven Cooking-Energy Efficiency and Idle Energy Rate Requirements:

| Table 2: Energy Efficiency and Water Consumption Rate Requirements for Combination Ovens |
|----------------------------------------|---------------------------------|---------------------------------|
| **Gas: 5-40 Pan Capacity** | **Operation** | **Idle Rate, Btu/h** | **Cooking-Energy Efficiency, %** |
| Steam Mode | ≤ 200P+6,511 | ≥ 41 |
| Convection Mode | ≤ 140P+3,800 | ≥ 57 |
| **Electric: 5-40 Pan Capacity** | **Operation** | **Idle Rate, kW** | **Cooking-Energy Efficiency, %** |
| Steam Mode | ≤ 0.133P+0.6400 | ≥ 55 |
| Convection Mode | ≤ 0.083P+0.35 | ≥ 78 |
| **Electric: 3-4 Pan Capacity and 2/3-size with 3-5 Pan Capacity** | **Operation** | **Idle Rate, kW** | **Cooking-Energy Efficiency, %** |
| Steam Mode | ≤ 0.60P | ≥ 51 |
| Convection Mode | ≤ 0.05P+0.55 | ≥ 70 |

**Water Consumption Rate: All Combination Ovens**

| Operation | **Electric and Gas During Idle Periods (gal/hr/pan)** | **Electric and Gas During Cooking Periods (gal/hr/pan)** |
| Steam Mode | Reporting Requirement | < 1.0 gal/hr/pan |
| Convection Mode | Reporting Requirement | < 0.5 gal/hr/pan |

Note: P = Pan capacity as defined in Section 1.Z, above.

C. Rack Oven Baking-Energy Efficiency and Idle Energy Rate Requirements:

| Table 3: Energy Efficiency and Water Consumption Rate Requirements for Rack Ovens |
|----------------------------------------|---------------------------------|---------------------------------|
| **Gas** | **Oven Size** | **Total Energy Idle Rate, Btu/h** | **Baking-Energy Efficiency, %** |
| Single | ≤ 25,000 | ≥ 48 |
| Double | ≤ 30,000 | ≥ 52 |

**Water Consumption Rate: All Racks Ovens with Steam Injection Mode**

<table>
<thead>
<tr>
<th>Mode</th>
<th><strong>Steam Generation Period (gal/min)</strong></th>
<th><strong>Reporting Requirement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Injection Mode</td>
<td>Reporting Requirement</td>
<td></td>
</tr>
</tbody>
</table>

Note: The ENERGY STAR commercial ovens product types represent approximately 51% of the market based on the ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2019 Summary. This estimate was recently updated to 54% of the market, ENERGY STAR Unit Shipment and
Market Penetration Report Calendar Year 2020 Summary. These market penetration estimates take into account U.S. shipment information, not North American shipments.

Some stakeholders question the representativeness of the overall market penetration rate and individual sub-category market penetration rates in the industry, suggesting that the overall market penetration and individual sub-category market penetration might be 1-5 percentage points lower or higher. The Agency recognizes that ENERGY STAR partners do not represent the entire market and has published adjusted estimates in the 2019 and 2020 summary reports. Further, the U.S. sub-category market penetration (shipment) rates are also summarized within the data packet in tab “11. MS ENERGY STAR”. The current market penetration estimates for convection and combination oven sub-categories ranged from 47%-75% and 47%-71%, respectively. These market penetration estimates are sufficiently high to trigger revisions for most oven sub-categories. Partners and stakeholders are encouraged to share any additional market data for EPA consideration.

Some stakeholders were also interested in payback assessments. EPA analyzes payback by assessing whether it is reasonable to expect a range of models to have favorable consumer payback at the proposed efficiency level. To effectively evaluate the payback period for ENERGY STAR equipment, EPA identifies and compares a limited set of like models (a model at or near the baseline efficiency versus a model at or just beyond the proposed ENERGY STAR criteria) to isolate a reasonable incremental cost due to the efficiency improvements. The payback analysis is included in the data packet tab “4. Incremental Cost and Payback”.

Most of the energy performance data (approximately 75% of the dataset) used to propose idle and cooking-energy efficiency levels in Tables 1 and 2, above, are primarily based on data from ENERGY STAR’s QPL, other incentive program’s QPLs, and stakeholder-submitted data. The remaining data consists of less efficient baseline data from California’s Technical Reference Manual (TRM). Specific models were removed from the dataset based on stakeholder feedback or because they were miscategorized or were discontinued.

Convection Ovens

One stakeholder commented on energy efficient technologies for combination ovens and the possibility of implementing some of these technologies and features into convection oven designs. However, other stakeholders noted that energy efficient technologies could not be implemented in a cost-effective and timely manner in the short term, adding that convection ovens provide different needs, serve a distinct market segment, and are unique from combination ovens. EPA agrees with these comments. Therefore, convection ovens continue to be a separate category with distinct criteria. Over time, the proposed levels may encourage the development of additional energy efficient technologies for convection ovens.

Several stakeholders commented on the electric full-size convection oven criteria level advocating for more stringent minimum efficiency levels. Other commenters proposed less stringent thresholds due to Draft 1 exclusion of several higher production capacity ovens. They offered, in one case, three strategies for including production capacity more directly into the convection oven criteria to fairly include higher capacity units:
   1. Binning by production capacity rates
   2. Redefining the full-size and half-size sub-categories by production capacity
   3. Adjusting the idle energy rate equation by normalizing it by production capacity

Production capacity is a critical decision-making tool for operators, and it is an additional factor EPA communicates to consumers through the Product Finder. EPA proposes binning full-size electric convection ovens by sheet pan capacity to include higher capacity ovens and more correctly distinguish between low capacity and high capacity ovens in the dataset. Initial stakeholder feedback supports this approach, and that sheet pan capacity can be a proxy for production capacity. Ultimately, binning by the number of sheet pans appears to be a more straightforward, intuitive, and less variable approach.

On average, full-size electric convection ovens tend to hold five sheet pans. Based on stakeholders’ feedback and EPA’s analyses, smaller capacity (<5 sheet pans) full-size electric convection ovens have different idle energy rates to ovens with higher capacities (≥ 5 sheet pans). Both high and low-capacity full-size electric convection ovens tend to have similar cooking-energy efficiencies. Therefore, EPA proposes that higher capacity electric convection ovens have an idle rate of ≤1.4 kW, and the lower capacity ovens...
have an idle rate of $\leq 1.0$ kW. The cooking-energy efficiency was only slightly increased (from 75% to 76%) to recognize approximately 30% of the most efficient full-size electric convection ovens.

Commenters expressed concerns about the proposed criteria for full-size gas convection ovens limiting consumer choice. On average, approximately 22% of available brands pass current criteria, providing several options to consumers. Further, the convection mode cooking-energy efficiency was adjusted from 50% to 49% to continue recognizing about 25% of the most energy efficient models. Any additional data on less efficient models in the market can help determine if current criteria are too stringent.

**Combination Ovens**

Oven manufacturers presented test data with varying steam saturation levels (SSL), which are possible in the ASTM test method. During testing, unstandardized humidity levels resulted in varying idle rates and cooking-energy efficiencies, affecting food appearance to varying degrees, which is a proxy for quality. EPA proposes maintaining Version 2.2 steam idle rate and steam cooking-energy efficiency metrics until the ASTM committee agrees on a standard humidity or SSL level. On the other hand, convection idle rates for electric and gas combination ovens have been adjusted and are more stringent from Draft 1 to continue recognizing about 25% of the most energy efficient combination oven models. While developing criteria, EPA attempts to have similar passing rates across a range of similar steam pan capacities and consumer choices that offer significant energy savings.

EPA received support for the approach of binning smaller combination ovens (3-4 steam pan capacity and 2/3-size pan models). The smaller combination ovens criteria may result in more energy per pan; however, binning them together allows greater consumer choice in line with different use cases and recognizes the most efficient units within this market segment. EPA expects that smaller combination ovens will begin to apply energy efficient designs seen in electric combination ovens (5-40 steam pan capacity), such that the Agency will revisit this binning approach in the future.

**Water Consumption Criteria**

Since the Commercial Ovens Version 2.0 Specification’s effective date (January 1, 2014), the Agency has collected water consumption rates as an additional reporting requirement for ENERGY STAR certified combination ovens during cooking periods in convection and steam modes. EPA used the reported water consumption rates originally in units of gallons per hour (GPH) and converted them to gallons per hour per pan (or gal/hr/pan) as a baseline for proposing maximum water consumption levels for combination ovens operating during cooking periods in steam and convection modes, located in Table 2 Section 3.B.

Additional water consumption rate data will be collected for combination ovens during the idle periods in convection and steam modes.

Several standards have incorporated water consumption thresholds for combination ovens, for example, ASHRAE 189.1-2020 Standard for the Design of High-Performance Green Buildings (10 gallons per hour in full operational mode), Leadership in Energy and Environmental Design (LEED) Version 4.1 (<1.5 gallons per hour per pan including condensate cooling water), and ANSI/GBI 01-2019 Green Globes Assessment Protocol for Commercial Buildings (<1.5 gallons per hour per pan in steam mode). In recognition of this interest across building standards and the cost and environmental benefit of water savings, EPA proposes setting a maximum water consumption rate for gas and electric combination ovens to encourage innovations targeting both water and energy.

EPA analyzed data from ENERGY STAR’s QPL to determine a maximum water consumption rate of <1.0 gallons per hour per pan for steam mode during cooking periods and <0.5 gallons per hour per pan in convection mode during cooking periods for all combination ovens. The proposed maximum water consumption rates result in a pass rate of approximately 25-29% for electric and gas combination ovens. These new water consumption thresholds account for boiler-based and boiler-less steam generation systems.

The Agency did not collect water consumption data for convection or rack ovens in Version 2.0; therefore, EPA is not proposing water consumption rate criteria for either oven category. Instead, the water consumption rate for convection and rack ovens will be an additional reporting requirement to inform customers about water consumption rates and savings opportunities.
Several stakeholders commented on the water consumption rate’s units for combination ovens (gallons per hour per pan, or gal/hr/pan), preferring alternatives such as gallons per hour (GPH; the rate reported in ASTM 2861-20) or gallons per pan (GPP), an alternative rate independent of time. Due to stakeholder support of the gal/hr/pan unit during Version 2.0 specification development as well as the significant pan-capacity variation in the oven market, EPA suggests that water consumption continues to be reported in gal/hr/pan. Normalizing the water consumption per pan allows end-users to compare the water consumption rates of the ovens with similar capacities. Additionally, the gal/hr/pan rate aligns with LEED and the Green Globes standards. However, without a leading consensus among currently active stakeholders regarding the water consumption units, EPA would like to discuss this topic further and encourage written feedback.

Creating a maximum water consumption threshold may also aid in the steam mode discussion concerning steam saturation levels. A water consumption rate threshold may also further advance condensate cooling design.

EPA encourages stakeholder feedback on the water consumption rates (gal/hr/pan and gal/min), the maximum water consumption criteria, and proposed energy criteria levels. EPA is also interested in reviewing any additional energy and water performance data to ensure that the dataset represents currently available products in the marketplace.

D. Additional Idle Calculation Guidance: Compliance with the convection oven and combination oven idle rate requirements shall be based on gas energy only for purposes of certifying gas models. When calculating the gas oven idle rates, electric energy consumed by auxiliary components shall not be considered. However, the electric energy consumption measured during idle tests shall be reported separately, as per Section 4.G.c.

E. Additional Total Idle Calculation Guidance: Compliance with the rack oven total idle rate requirements shall be based on gas and electric energy for purposes of certifying gas models. When calculating the gas rack oven total idle rates, electric energy consumed by auxiliary components shall be converted to Btu/h and added to the gas idle rate expressed in Btu/h. The electric energy consumption measured during idle tests shall also be reported separately as expressed in kW, as per Section 4.G.c.

Example: Consider a double-sized gas rack oven with a gas idle energy rate of 30,000.11 Btu/h; and the electric idle energy rate of 1.51 kW. First, convert the 1.51 kW electric idle energy rate to Btu/h by multiplying the 1.51 kW by 3,412.14. Then add the result to the 30,000.11 Btu/h gas idle rate.

\[ 1 \text{ kW} = 3,412.14 \text{ Btu/h} \]
\[ \text{Electric idle energy rate, converted to Btu/h: } 1.51 \text{ kW} \times 3,412.14 \text{ Btu/h} = 5,152.3314 \text{ Btu/h} \]
\[ \text{Total idle energy rate: } 30,000.11 \text{ Btu/h} + 5,152.3314 \text{ Btu/h} = 35,152.44 \text{ Btu/h} \]

F. Significant Digits and Rounding:

a. All calculations shall be carried out with directly measured (unrounded) values. Only the final result of a calculation shall be rounded.

b. Unless otherwise specified in this specification, compliance with certification criteria in Section 3 shall be evaluated using exact values without any benefit from rounding.

c. Cooking and Baking-Energy Efficiency: Calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the certification criteria in Section 3.

d. Idle Energy Rate: Calculated values for gas convection, combination, and rack oven idle rates submitted for reporting on the ENERGY STAR website shall be rounded to the nearest whole number. The calculated energy consumption values for electric convection and combination ovens shall be rounded to 0.01 for idle rates.
4. **Test Requirements:**

   A. Representative models shall be selected for testing per the following requirements:

      a. For certification of an individual product model, the representative model shall be equivalent to that which is intended to be marketed and labeled as ENERGY STAR.

      b. For a product family certification, any model within that product family can be tested and serve as the representative model. When submitting product families, manufacturers continue to be held accountable for any efficiency claims made about their products, including those not tested or for which data was not reported.

   B. When testing commercial ovens, the following test methods shall be used to determine ENERGY STAR certification

<table>
<thead>
<tr>
<th>Oven Types</th>
<th>ENERGY STAR Requirements</th>
<th>Test Method Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack Ovens</td>
<td>Baking-Energy Efficiency, Total Idle Energy Rate, Production Capacity, Steam Rate, Steam Injection Cycle, and Preheat time</td>
<td>ASTM F2093-18, Standard Test Method for Performance of Rack Ovens</td>
</tr>
</tbody>
</table>

   **Note:** Table 4 includes the water consumption rate, steam injection rate, and steam injection cycle captured as a reporting requirement for applicable convection and rack ovens. Since water consumption data for convection and rack ovens were not collected in Version 2.0, water consumption rate criteria are not proposed for those oven categories at this time. Reporting water consumption rates for convection and rack ovens will help customers calculate water use and potentially save on water and sewage costs.

   C. For ovens with variable Btu/h or kW input, each available input shall be tested and reported individually. Ovens need to meet the idle energy rate or total idle energy rate and cooking- or baking-energy efficiency requirements presented in Table 1, Table 2, or Table 3, of this specification at each input setting.

   D. For electric ovens with multiple voltage-versatility and those that are available in different voltage configurations, the representative oven shall be tested at the most energy consumptive voltage according to the manufacturer.

   E. If the representative combination oven model under test is designed to hold 18 x 26-inch sheet pans, the manufacturer-supplied wire racks shall be positioned in the oven to accommodate 12 x 20 x 2.5 -inch steam table pans.

   F. Combination ovens with roll-in, removable racks shall have the racks positioned in place during
steam mode and convection mode idle tests.

G. Additional Reporting Requirements:

a. The average water consumption rates, average steam injection rate, average steam injection cycle, average condensate drain temperatures, and the maximum condensate drain temperatures shall be reported for all applicable ovens and applicable modes.

b. The production capacity for all convection ovens, combination ovens, and rack ovens cooking or baking-energy efficiency tests shall be reported.

c. The electric energy idle rate for gas convection, combination, and rack oven idle rate tests shall be reported.

d. Rack ovens that include energy saving feature(s) and meet the minimum requirement of the set-back idle mode definition in Section 1.DD. shall be reported.

e. Preheat energy consumption and time for all convection, combination, and rack ovens shall be reported in Btu or kWh for energy consumption and in minutes for preheat time. For combination ovens, both steam and convection preheat energy consumption and time shall be reported. For gas ovens, the auxiliary components (e.g., fan energy consumption) that use electrical energy shall also be reported.

Note: To capture a more comprehensive total energy profile for all oven types within scope, EPA proposed in Section 4.G.e. to require collecting the preheat energy consumption and time from partners. A stakeholder preferred not publishing preheating metrics since it might confuse customers, while others expressed that they are helpful metrics. Since this metric is beneficial to customers, EPA will include it in the QPL and will include a note briefly describing the test method. An additional note in the QPL will describe that condensate cooling water consumption is included for ovens using that technology.

5) Effective Date: This ENERGY STAR Version 3.0 Commercial Ovens specification shall take effect on TBD. To certify to ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the model’s manufacture date. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

Note: EPA anticipates finalizing this Version 3.0 specification in Q1 2022. Once a final specification is released, manufacturers may immediately begin certifying products to the new Version 3.0 specification, but will have nine months to transition to it, understanding that certification to the current version must cease 4.5 months after the final specification is published. Once the Version 3.0 specification takes effect, ovens that do not meet the criteria will be removed from the ENERGY STAR Product Finder and may no longer be marketed or labeled as ENERGY STAR unless retested and recertified.

6) Future Specification Revisions: EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that ENERGY STAR certification is not automatically granted for the life of a product model.