ENERGY STAR Market & Industry Scoping Report
Toaster Ovens
November 2011

The U.S. Environmental Protection Agency (EPA) consistently looks for new opportunities to expand ENERGY STAR to new product categories that will deliver significant benefits to consumers and the environment in the form of energy and dollar savings plus greenhouse gas reductions. A key step in this evaluation is the development of a scoping report that provides a snapshot of the product market, energy use, and savings potential associated with an ENERGY STAR program for the scoped product type. EPA uses scoping findings to prioritize product specification development work. While scoping reports are drafted primarily for internal evaluation purposes, and are not intended to be exhaustive but rather a guidepost for the ENERGY STAR program, EPA makes the reports available with the interest of benefiting other efficiency program evaluating similar opportunities. For more information about the ENERGY STAR specification development process, go to: www.energystar.gov/productdevelopment.

1. Product & Technology Overview

Toaster ovens are countertop appliances designed for toasting, baking, broiling, defrosting, and warming food. Most toaster ovens are significantly larger than toasters, but are capable of performing most of the functions of electric ovens, albeit on a much smaller scale. Toaster ovens range from about 16 x 8-inch to 20 x 10-inches in footprint. Toaster ovens are designed for usability, ease of maintenance, cooking functions, safety, and capacity.

Product Types

Conventional Toaster Oven: Designed for toasting, baking, and broiling. Standard accessories include a baking pan and removable crumb tray / drip pan for easy maintenance.

Convection (fan-forced) Toaster Oven: Augments a conventional toaster oven configuration with a fan to circulate heated air inside the cooking compartment, which results in a more even temperature throughout and allows multiple shelves to be used simultaneously. More heat is transferred to the food through the combination of convective and radiative heat transfer than would otherwise be transferred through radiative heating alone – thus reducing the time and/or temperature needed to complete cooking.

Product Features

- Heating Element: An electric resistance coil, infrared lamp, or other device that is used to generate heat for cooking.
- Thermostat: Maintains a constant temperature in the cooking compartment by cycling power to the heating elements.
- Fan: Circulates air within the cooking compartment for even heat distribution. Areas of higher velocity accelerate evaporation and heat transfer. Electric fans are usually located at the back of the oven cavity with the fan motor situated outside of the insulated enclosure. The fan motor is typically cooler in temperature although some heat is conducted along the fan drive shaft.
- Timer: Provides capability to shut off the oven at the end of the cooking process.
- Interior Lamp: Provides light to allow users to monitor cooking progress.
- LCD Display: Provides clock and timer functions.

- Insulation: Insulation improves cooking efficiency by retaining heat inside the cooking compartment.
- Cooking Compartment: Toaster ovens are often differentiated by bread slice capacity or interior volume. The interior volume of a 4-slice model is typically 0.35 cu. ft. and a 6-slice model is typically 0.5 to 0.7 cu. ft. 6-slice models account for the largest sales volume in the U.S. market.
- Warming Compartment: A separate heated compartment, usually on top of the cooking compartment, that is used for defrosting or keeping food warm while the oven is in use.

Toaster ovens heat food through conduction, convection, and radiation. Various technologies are employed in toaster ovens to achieve a combination of these basic processes.

Conduction: Conduction is the direct transfer of heat from a hot object into a cooler one in contact with it. This process occurs in toaster ovens where the baking pan or toaster oven rack is in contact with food. Cookware varies from high conductivity (aluminum and copper) to low conductivity (glass and porcelain).

Convection: Heat is transferred through convention currents in a gas or liquid. There is a small amount of moving-air convection taking place in a toaster oven, but in a "convection toaster oven" a built-in fan intensifies the circulation, encompassing all parts of the food equally.

Electromagnetic Field Radiation: Radiation is the transfer of heat by direct exposure to a source of energy. Infrared radiation emitted by the heating element is the primary mechanism for transfer of heat in a toaster oven to food. When radiation strikes a substance, its energy agitates the substance's molecules, making it hotter.

2. Market Assessment

U.S. Retail Sales

Convection toaster ovens continue to gain market share. The steady growth of the technology, coupled with growing consumer understanding of its key benefits, has continued to move convection close to becoming a cost-of-entry feature within the toaster ovens category.

Other features that continue to gain ground include touch pad and electronic controls, expanded capacity, LCD timers, and automatic shut-off. From a macro-perspective, the countertop category continues to move in the direction of giving consumers the same features and functionality they've come to expect in full-size ovens in a more compact footprint. HomeWorld Business estimates that 22% of units sold in 2010 had electronic controls, versus 78% without electronic controls.

The proliferation of new models, which in turn have driven more widespread distribution have helped put the category increasingly in front of consumers and continue to accelerate household penetration.[1]

[1] "Housewares Census 2011," HomeWorld Business, January 2011.

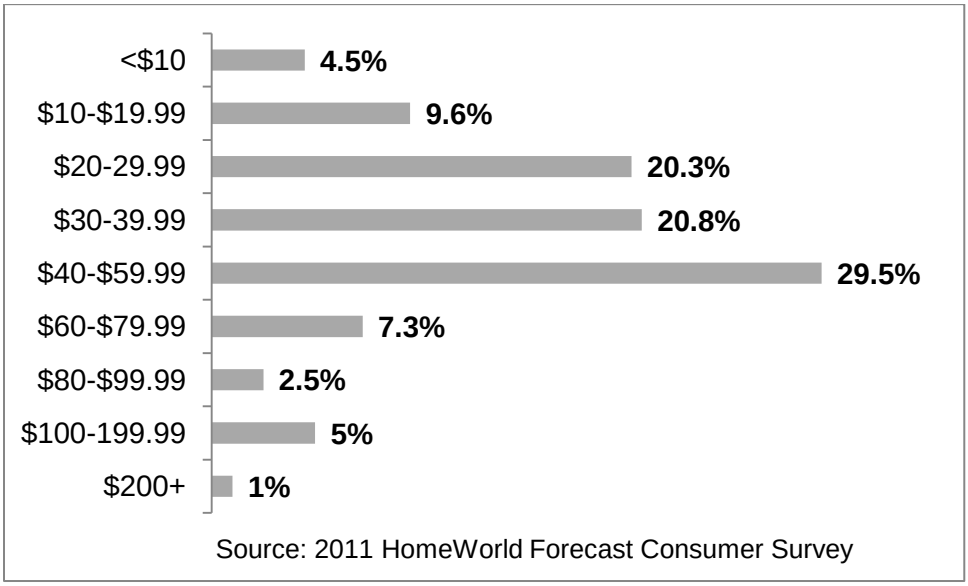
Table 1: U.S. Retail Sales of Toaster Ovens – 2010[2]

Product Type	Retail Dollar Sales (millions)	Market Share by Retail Dollar Sales	Retail Unit Sales (millions)	Market Share by Retail Unit Sales
Conventional Toaster Ovens	332.02	57%	7.03	67%
Convection Toaster Ovens	250.1	43%	3.4	33%
Total	**582.12**		**10.43**	

U.S. Retail Pricing: Residential

The retail price of toaster ovens ranges from $20 to $250. According to industry representatives, pricing is dependent upon style, finish, and features, and not energy efficiency. Results from the HomeWorld Forecast 2011's annual survey of consumers, shown below, indicate most consumers expect to pay between $20 and $60 for conventional toaster ovens.

Table 2: U.S. Conventional Toaster Oven Purchase Price Expectation[3]



3. Energy Efficiency Assessment

Available Test Procedures

- AHAM T-1-1986, *Household Electric Toasters*: Used for measuring the performance of toaster ovens but does not measure energy consumption. However, the Association of Home Appliance Manufacturers (AHAM) has considered developing a new test method for measuring energy consumption.[4]

[2] Ibid.
[3] Ibid.
[4] American Home Appliance Manufacturers (AHAM). www.aham,.org.

- EN 61817: 2001, Household portable appliances for cooking, grilling and similar use: Methods for assessing performance are described. There is also an energy consumption measurement procedure (in Wh).

- IEC-62301, *Household Electrical Appliances - Measurement of Standby Power*: An international test method for measurement of standby power consumption and may be applicable to toaster ovens.

In addition, Savenia Labs is also developing test procedures for rating the energy performance of several countertop appliances, including toaster ovens.[5]

Product Usage Patterns

Energy consumption in toaster ovens can be strongly influenced by user behavior. Main factors include the temperature settings, the duration of the cooking process, or the frequency with which the oven door is opened. These factors can vary considerably depending on individual cooking habits. The different settings in temperature and duration are also influenced by consumer's expectations on the cooking results. These expectations and practices can relate to regional differences, but can also depend on individual preferences.

- Power Consumption: According to industry representatives, a toaster oven uses about 1/3-1/2 less energy than a conventional electric oven for cooking small meals. Typical power consumption of a toaster oven during use is 1,200 to 1,400 watts. Bake, toast, and keep-warm functions use more power on average than broil- and slow-bake functions. For a 6-slice toaster oven, bake and toast functions consume 900 to 1,400 watts, the keep-warm function consumes 600 to 1,400 watts, the broil function consumes 800 to 1,200 watts, and the slow-bake function consumes approximately 600 watts.
- Standby Power Consumption: Approximately 55% of households leave their toaster ovens plugged in when not in use. According to one industry source, digital control toaster ovens consume less than 0.2 watts in standby mode, while manual control toaster ovens do not consume any power in standby mode.
- Life Expectancy: The average life expectancy of toaster ovens is 5 years.[6]
- Frequency and Duration of Usage: Toaster ovens are primarily used for toasting and baking, and rarely used to defrost, warm or broil food. 27% of households use their toaster oven for only toasting, while 7% use it for only baking. The frequency and duration of toaster oven usage is shown in the charts below. The data presented in these charts is from a 2009 survey of over 2,300 respondents, (a representative sample of U.S. households) conducted by AHAM.[7]

[5] For more information, see: http://www.savenialabs.com/
[6] *31st Annual Portrait of the U.S. Appliance Industry*, September 2008, Appliance Magazine
[7] Association of Home Appliance Manufacturers, "Portable Home Appliances Saturation & Usage Study," July 2009.

Table 3: Frequency of Use: Toaster Ovens

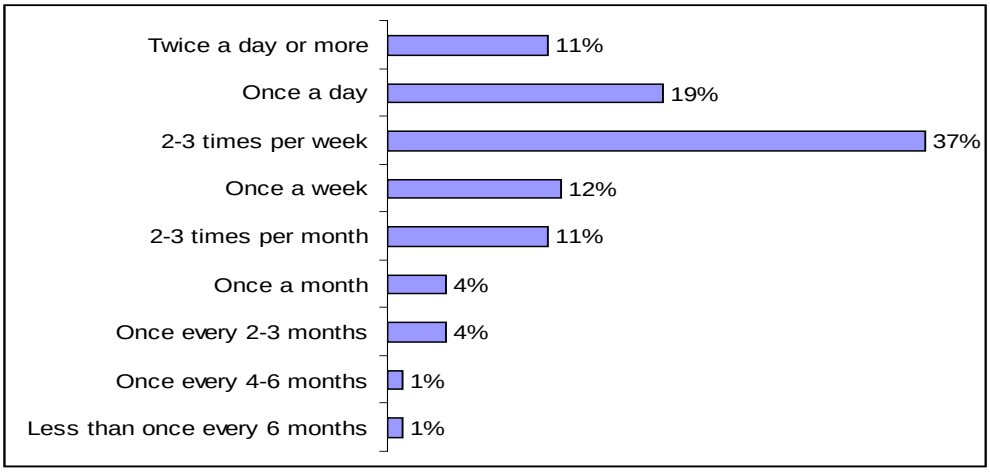
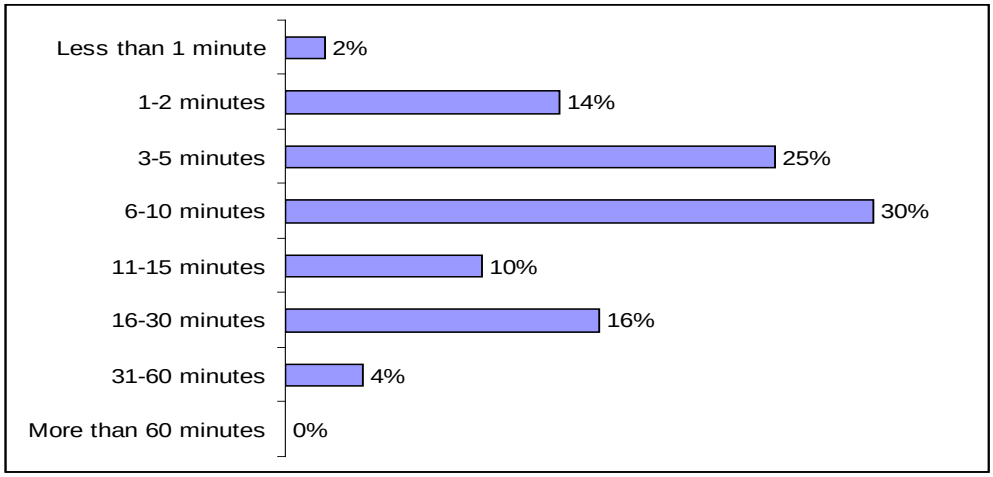


Table 4: Duration of Use: Toaster Ovens



4. Energy and Cost Savings Potential

Full-size ovens are not very efficient for cooking small- to medium-sized meals. Cooking a meal in a toaster oven has the potential to save over 50% of the energy used to cook the same meal in a conventional electric oven.[8] In addition, the following improvements can increase the efficiency of a toaster oven.

Convection technology

One source cites that convection toaster ovens save up to 40% in energy compared to traditional toaster ovens. However, due to the lack of a standardized test procedure, data was not found that could substantiate this type of claim.[9] Testing by Savenia Labs also suggests that conventional and convection toaster ovens use approximately the same amount of energy over a given time period. Based on this testing, they also suggest that whether or not temperature and/or cook time are reduced is less important since toaster ovens use the vast

[8] Amann, Jennifer Thorne., Alex Wilson, and Katie Ackerly. *Consumer Guide to Home Energy Savings*. Washington, D.C.: American Council for an Energy-Efficient Economy, 2007. Print.
[9] http://www.livingincomfort.com/consumer-guides/toaster-ovens-guide.html

majority of their energy over a short cooking cycle to pre-heat, and therefore, small reductions in temperature or cook time will have minimum impact on energy consumption.[10]

Insulation

The walls of a range oven are insulated better than a toaster oven. They must have thicker wall insulation to keep the outside safely cool to prevent accidental burns when they are in the superhot self-cleaning cycle. Many toaster ovens have single layers of glass. Toaster ovens could achieve increased energy efficiency by improving door and cooking cavity insulation.

Electronic temperature control

This would allow better control of the heat inside the toaster oven cavity. Gains in energy efficiency can be achieved by more accurately controlling the heat output of the oven.

Improved door seals

Early research showed a 7% energy efficiency improvement is possible, whereas recent work attributed only a 1% improvement.[11]

Cooking sensors

Monitoring the temperature of the food would enable the temperature inside the toaster oven to be adapted for less energy loss and better cooking performance. Savings potential is user-dependent, however, and would mainly benefit consumers who over-estimate cooking time or forget to intervene when cooking is finished.

Estimated Savings Potential

Given that there is currently no widely adopted procedure in the U.S. for measuring the usage energy consumption of toaster ovens, comprehensive and comparable data are not currently available. For the purposes of this report, considering the efficiency options discussed above, a 15% reduction in active mode power draw (from 1.4 kW to 1.2 kWh)[12] is assumed in order to develop an initial estimate of the energy savings opportunity. Assuming a toaster oven is used 36 hours in a year,[13] the annual savings from an efficient toaster would be on the order of 7 kWh/yr. Considering there are approximately 1.7 million toaster ovens sold in the U.S. each year, the national energy savings opportunity would be on the order of 13,000 MWh per year if 25% of products sold were replaced with energy efficient models. This reduction in energy use would reduce CO_2 emissions by approximately 20 million lbs (assuming a conversion of 1.54 lbs CO_2 per kWh).

[10] Savenia Labs Blog, *Convection Bake: Does it Save Energy?* Posted September 5, 2011. http://www.savenialabs.com/blog/
[11] U.S. Department of Energy. EERE. Chapter 3. Market and Technology Assessment. Final Rule Technical Support Document: Residential Dishwashers, Dehumidifiers, and Cooking Products, and Commercial Clothes Washers, Mar. 2009. Web. <http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/cooking_products_tsd_ch3.pdf>.
[12] Figures based on energy consumption of 6-slice models.
[13] Total annual usage figures derived from weighted average estimates of product usage pattern data provided by Portable Home Appliances Saturation & Usage Study 2009

5. Key Market Players

Industry Associations

Association of Home Appliance Manufacturers (AHAM): AHAM is a trade association of home appliance manufacturers. AHAM performs market research and supplies business data to its members. AHAM does not currently offer a certification program for toasters and toaster ovens.

Manufacturers

- Applica Organization (Black & Decker, George Foreman)
- Avanti
- Cuisinart
- De'Longhi America (De'Longhi, Kitchen Electrics)
- Euro-Pro
- Groupe SEB (Krups, T-Fal, Rowenta, Wear Ever, AllClad)
- Hamilton Beach (GE)
- Jarden Consumer Solutions (Sunbeam, Oster, Holmes, Rival)
- Panasonic
- Proctor Silex
- Rival
- Sanyo
- Sunpentown
- Toastmaster
- Whirlpool Corporation (KitchenAid)