EXECUTIVE SUMMARY
Better Appliances: An Analysis of Performance, Features, and Price as Efficiency Has Improved
May 2013

Efficiency standards have played a major role in saving energy and water and reducing utility bills. In this report, we analyze how the choices available to consumers have changed over time as efficiency standards have taken effect for ten residential, commercial, and lighting products. We found that as products have become more efficient:

- Performance generally stayed the same or improved;
- Manufacturers offered new features to consumers; and
- Prices *declined* or stayed the same for five of the nine products for which we could obtain price data, and for the other four products, observed price increases are outweighed by electricity bill savings.

Using the best available data, we compared products available before and after national efficiency standards took effect and evaluated how three product dimensions—performance, features, and price—have changed over time. For most of the ten products, we examined the current standard (which in three cases was also the first national standard established for the product). However, for refrigerators, clothes washers, and dishwashers, we examined multiple standards that have taken effect over the last 20-25 years. For these three products, sufficient historical data were available to examine how they have changed over time as standards have been established and updated.

Where possible, we examined models available at three points in time: when the standard was established; one year after the standard took effect; and today. Table ES-1 below shows the specific performance attributes and product features that we examined for each of the ten products.

Table ES-1. Products, Performance Attributes, and Features Examined

Refrigerators		Clothes Washers	
	• Temperature performance • Door configuration • Volume • Through-the-door ice • Noise • Additional features • Efficiency • Price		• Washing performance • Method of loading • Tub capacity • Cycle time • Automatic temperature control • Additional features • Efficiency • Price

Dishwashers		Residential Central Air Conditioners and Heat Pumps	
	• Washing performance • Cycle time • Tub material • Delayed start feature • Additional features • Efficiency • Price		• Cooling capacity • Size and weight • Dehumidification • Additional features • Efficiency • Price
Toilets		**General Service Light Bulbs**	
	• Flush performance • Bowl cleaning • Style • Efficiency • Price		• Light output • Light color • Dimmability • Lifetime • Efficiency • Price
Incandescent Reflector Lamps		**Fluorescent Lamp Ballasts**	
	• Light output • Light color • Dimmability • Lifetime • Efficiency • Price		• Ballast factor • Lifetime • Additional features • Efficiency • Price
Commercial Rooftop Air Conditioners and Heat Pumps		**Refrigerated Beverage Vending Machines**	
	• Cooling capacity • Size and weight • Additional features • Efficiency • Price		• Machine type • Volume • Controls • Customer interaction features • Efficiency • Price

Performance

We found that product performance generally stayed the same or improved as efficiency standards took effect. Refrigerator temperature performance has improved and noise levels have dropped over time. Manufacturers have maintained good dishwasher performance even as energy and water use have decreased substantially. General service light bulbs and incandescent reflector lamps that meet new efficiency standards provide the same light output, lifetime, color quality, and dimmability as lamps that

were available before standards took effect. Electronic ballasts are quieter and lighter than older less efficient magnetic ballasts and do not produce the visible flicker that is characteristic of magnetic ballasts. And there was no significant difference in the range of available cooling capacities of residential and commercial air conditioners and heat pumps before and after standards took effect.

In just two instances (clothes washers and toilets), an increase in poor performance ratings was reported immediately after the implementation of efficiency standards. However, this effect was temporary. Manufacturers responded by eliminating or re-designing poorly-performing models, and the incidence of poorly-performing models declined. More importantly, over the longer term, performance has improved beyond what was available before the standards. Many clothes washers today do a better job of removing stains and are gentler on clothes than older washers, and today's consumers have enormous choice of toilets with excellent flushing performance.

Features

We found that for each of the ten products we evaluated, manufacturers introduced and expanded the availability of new features as efficiency standards took effect. The average volume of available refrigerator models has increased over time; consumers now have a significantly wider range of options in bottom-freezer units including French-door models; and refrigerators offer a range of new features including new types of water dispensers, in-the-door ice makers, and additional compartments. The availability of clothes washers with large tub capacities has increased dramatically, and new features include electronic controls and displays, steam cycles, and automatic dispensers. Features such as stainless steel tubs and delayed start have become more common on dishwashers, even on low-price-point models. Most central air conditioners now have thermal expansion valves, which can improve both comfort and efficiency and increase equipment reliability. And manufacturers have introduced efficient halogen incandescent and LED light bulbs, which were previously unavailable.

Price

We found that prices *declined* or stayed the same as efficiency standards took effect for five of the nine products we evaluated for which we could obtain price data.[1] Between 1987 and 2010, real prices of refrigerators, clothes washers, and dishwashers decreased by 35%, 45%, and 30%, respectively. For toilets and fluorescent lamp ballasts, the incremental cost of the more efficient products at the time the standards were established had disappeared either by the time the standard took effect (in the case of fluorescent lamp ballasts) or within two years after the standard took effect (in the case of toilets). For general service light bulbs and incandescent reflector lamps, prices have increased modestly, but the total cost (purchase price plus operating cost) is lower for the lamps meeting the new standards compared to pre-standard lamps. Finally, for residential and commercial air conditioners and heat pumps, observed price increases are likely attributable at least in part to significant increases in metal prices, which are independent of efficiency standards. However, even if the entire price increases were due to the standards, the payback periods (six years and three years for residential and commercial units, respectively) are significantly shorter than the average lifetimes of this equipment (19 years and 15 years, respectively).

In sum, we found that as efficiency standards have taken effect, product performance generally stayed the same or improved, and manufacturers offered new features to consumers. Prices *declined* or stayed the same for five of the nine products we evaluated for which we could obtain price data, and for the other four products, observed price increases are outweighed by electricity bill savings.

[1] We were unable to evaluate how refrigerated beverage vending machine prices have changed due to a lack of data. However, we found that the manufacturer selling price decreased in the decade before the efficiency standard took effect, while energy use decreased significantly.

ACKNOWLEDGMENTS

The authors would like to thank the following people for reviewing drafts and providing comments on this report: Kevin Messner (Association of Home Appliance Manufacturers); Jim McMahon (on behalf of the Collaborative Labeling & Appliance Standards Program); Mark Cooper and Mel Hall-Crawford (Consumer Federation of America); Shannon Baker-Branstetter, Mark Connelly, and Celia Lehrman (Consumers Union); John Wilson (Energy Foundation); Alex Chase, Amanda Gonzalez, Heidi Hauenstein, Bijit Kundu, Alex MacCurdy, Mike McGaraghan, Ted Pope, and Daniel Young (Energy Solutions); Amanda Stevens (Environmental Protection Agency); Alex Boesenberg and Kyle Pitsor (National Electrical Manufacturers Association); Meg Waltner (Natural Resources Defense Council); David Lis (Northeast Energy Efficiency Partnerships); David Cohan (Northwest Energy Efficiency Alliance); Tom Eckman (Northwest Power and Conservation Council); Keith Cook and Randall Moorhead (Philips Electronics); Bill Gauley; John Koeller; and Michael McCabe.

We would also like to thank the following ACEEE and ASAP staff members for reviewing drafts and providing comments: Jennifer Amann, Marianne DiMascio, and Harvey Sachs. Finally, we would like to thank the following communications staff for their help in editing and producing this report: Patrick Kiker, Renee Nida, and Eric Schwass.