



Understanding and Designing Residential Appliance Efficiency and Recycling Programs

The U.S. Environmental Protection Agency (EPA) is providing this summary to help inform energy efficiency program administrators about opportunities to help customers save money and reduce energy use with ENERGY STAR® certified appliances and through the retirement and recycling of old, inefficient equipment. Common practices for program design and implementation are shared based on the experience of recent programs around the nation.

ENERGY SAVINGS POTENTIAL

ENERGY STAR certified major appliances have delivered tremendous energy, environmental, and economic savings since they were first introduced in 1996—saving Americans about \$1.5 billion a year in energy costs. Over the years, EPA and the U.S. Department of Energy (DOE) have ratcheted up performance specifications to respond to market conditions and changes in Federal appliance standards with tremendous result. Today, a typical refrigerator that has earned the ENERGY STAR uses less energy than a 60-watt light bulb (operated continuously) and is 15 percent more energy efficient than models that meet the federal minimum energy efficiency standard. ENERGY STAR clothes washers use 35 percent less water and about 20 percent less energy for washing and drying, which translates to approximately 700 kWh and about two million BTUs of natural gas savings over the life of the appliance.

Despite these advances, major appliances including refrigerators, dishwashers, clothes washers and dryers, and water heaters still comprise more than a quarter of household energy use and remain an important target for the ENERGY STAR program and energy efficiency program portfolios. In addition, for refrigerators and freezers in particular, it is important to ensure that old models are properly retired and recycled to ensure they don't end up in a garage or basement as a second refrigerator, increasing rather than decreasing household energy load.

The table below estimates energy savings for ENERGY STAR certified products above federal minimum standards for current and anticipated ENERGY STAR specifications (as available). Savings estimates for specifications under development are subject to change.

Exhibit 1: Saving Estimates from ENERGY STAR Certified Appliances 2012-2014

Product Category	Year	Federal Minimum Standard (Baseline) Energy Consumption	ENERGY STAR Energy Consumption	Annual savings over baseline	
				Electric (kWh)	Gas (therms)
Refrigerator ¹	1/1/2012 – 2/28/2014 (Version 4.1)	572 kWh/yr	458 kWh/yr	114 kWh/yr	
Refrigerator ²	3/1/2014 – 12/31/2014 (Version 5.0 under development)	527 kWh/yr	474 kWh/yr	53 kWh/yr	

¹ Based on a weighted average of top-freezer, bottom-freezer, and side-by-side refrigerators.

² Based on updated federal standards and new Department of Energy test procedure. Same weighted average used for V4.1 used for V5.0.

Dishwasher	2012-5/29/2013 (Version 5.0)	355 kWh/yr	295 kWh/yr	60 kWh/yr	
Dishwasher ³	5/30/2013-2014 (Version 6.0 development launches 1/13)	307 kWh/yr	295 kWh/yr	12 kWh/yr	
Clothes Washer ⁴	2/1/2013 – 10/31/2013 (Version 6.0)	328 kWh/yr 30 therms/yr	188 kWh/yr 19 therms/yr	140 kWh/yr	11 therms/yr
Clothes Washer	11/1/2013 - 2014 (Version 7.0 under development)	328 kWh/yr ⁵ 30 therms/yr	145 kWh/yr ⁶ 15 therms/yr	183 kWh/yr	15 therms/yr
Clothes Dryer	New product under development	641 kWh/yr ⁷ 23.7 therms/yr	558 kWh/yr ⁸ 21.3 therms/yr	83 kWh/yr	2.4 therms/yr
Water Heater (Storage)	07/1/2013 (Version 2.0)	4,857 kWh/yr 261 therms/yr	2,195 kWh/yr 224 therms/yr	2,662 kWh/yr	37 therms/yr
Water Heater (Tankless)	07/1/2013 (Version 2.0 under development)	261 therms/yr	183 therms/yr	78 therms/yr	

PROGRAM DESIGN CONSIDERATIONS

ENERGY STAR certified appliances meet strict performance criteria that are technology neutral, providing a level playing field for current and future technologies while ensuring a positive consumer experience. To effectively tap into these savings, energy efficiency programs around the country evaluate local market conditions to determine how best to target program dollars.

Determining Product Criteria and Incentives

While base ENERGY STAR criteria offer a clear and easy path to leverage for most efficiency programs, administrators may need to focus promotions on a subset of ENERGY STAR certified products depending on local market conditions and mandates.

- It is common practice for single fuel utilities to promote only the ENERGY STAR certified products that use their fuel type for replacement equipment (e.g., a gas utility would promote ENERGY STAR certified gas water heaters). Utility commissions and environmental groups usually

³ ENERGY STAR specification has not been discussed for 2014. ENERGY STAR level kept constant. Federal standards are changing on May 30, 2013. Assumes 215 cycles per year.

⁴ Clothes washer savings only include the savings from the machine (7.6% for a conventional unit and 5.3% for an ENERGY STAR qualified unit) and water heating (33.7% for a conventional unit and 32.3% for an ENERGY STAR qualified unit). Percentages kept constant for Version 6 and Version 7 ENERGY STAR criteria. Dryer savings calculated via the clothes dryer line. Assumed volume of 3.4 cu-ft for all clothes washer calculations. Assumes 295 cycles per year.

⁵ Assumed MEF of 1.26

⁶ Assumed MEF of 2.0

⁷ Assumed MEF of 1.26

⁸ Assumed MEF of 2.6

discourage electric programs that promote fuel switching from gas to electric equipment. Some appliance programs are run regionally or statewide and are promoted to both electric and gas customers, which works well for consumers and suppliers.

- Whether to incentivize a product category at all or to incentivize only a subset of products within a product category is usually determined based on:
 - The market share of the efficient option—as a general rule of thumb, if market share has reached 50% or more, consumers are increasingly likely to purchase a product on their own without program financial incentives. The exception might be hard to reach customers such as those that are lower income or reside in multifamily dwellings;
 - The incremental energy (and water as applicable) savings of the efficient option above the standard efficiency option; and
 - The incremental cost of the efficient option.

For example, a program in an area with high market penetration of ENERGY STAR certified refrigerators may offer financial incentives for a subset of products or provide varying incentives based on efficiency levels. The marketing designation “ENERGY STAR Most Efficient” is available for some categories (including clothes washers and refrigerators) to highlight top performers in a given year. (For additional information and criteria, visit energystar.gov/moste efficient). ENERGY STAR Most Efficient is intended to appeal to environmentally conscious consumers and early adopters who want leading edge products in terms of energy efficiency. The designation allows partners to maintain their connection to the powerful ENERGY STAR brand while offering special promotions around a subset of products recognized by EPA as the “best of the best” for a given year.

- Incentives are usually aimed at reducing the higher first cost associated with ENERGY STAR certified major appliances. Incentives can be directed to consumers or to retailers and/or manufacturers who can then apply them to advertising, marketing and in-store discounts. Given the dynamic nature of today's residential appliance market, program design flexibility is recommended. Some programs have had success offering bonus incentives for a limited time to spur demand. Incentive levels may need to be adjusted as market conditions change.

Ensuring Responsible Appliance Recycling

For refrigerators and freezers in particular, it is important to ensure that the model being replaced doesn't get moved to and plugged in to the basement or garage increasing rather than decreasing household energy load. About a quarter of U.S. households already have a second refrigerator, many of which were manufactured before 1993, when the average refrigerator used 1,000 kWh annually—making removal of older units as a standalone program also compelling. As such, many efficiency programs promote recycling in accordance with EPA's Responsible Appliance and Disposal Program (see box at right) and offer turn-in incentives between \$40-\$50⁹ and cost-free pickup of the functioning older refrigerator or freezer. Key eligibility criteria usually include specifying that appliances need to be operational and in use at the time of pickup. Some programs also include rebates for recycling room air conditioners if they are already picking up a refrigerator or freezer. There are two major recycling contractors that offer turn-key program services (e.g., eligibility verification, appointment scheduling, appliance pickup, recycling and disposal, and incentive processing). In addition, several national retailers offer RAD recycling services either nationally or regionally. For more information visit, epa.gov/ozone/partnerships/rad/.

EPA's Responsible Appliance Disposal Program

EPA has defined best practices in appliance recycling as part of the Responsible Appliance Disposal (RAD) Program. RAD is a voluntary partnership designed to help protect the ozone layer and reduce greenhouse gas emissions. Partners in the RAD program recover ozone-depleting chemicals from old refrigerators, freezers, air conditioners, and dehumidifiers and either reclaim it for re-use or destroy it in accordance with program requirements.

Exhibit 2 on the next page provides savings estimates from refrigerator retirement for several vintages of refrigerators.

⁹ ENERGY STAR Summary of Appliance Programs 2012.

Exhibit 2: Estimate of Potential Savings from Retiring Refrigerators¹⁰

Refrigerator model year	Annual savings from retirement (kWh) ¹¹	Kept in use for 2 more years (kWh) ¹²	Kept in use for 5 more years (kWh) ¹³
2000	810	1,620	4,050
1990	1,180	2,360	5,900
1980	1,821	3,642	9,105

Marketing and Outreach

Marketing and outreach is important for educating consumers on the benefits of ENERGY STAR and for encouraging stocking and promotion of targeted products by local retailers. The following are common strategies used by efficiency programs throughout the nation.

- Consumer marketing, outreach, and education including coordinated promotions with the national *Change the World, Start with ENERGY STAR Campaign*, which runs from Earth Day to Earth Day.
- Outreach and training to a range of retailers including big box retailers, regional chains, buying groups and independent retailers to support promotion of ENERGY STAR certified appliances and to ensure that any rebate forms and other program information is available and terms and conditions are understood. Some programs employ “circuit riders” that visit local stores, talk with sales staff and ensure point of purchase and other marketing materials are available and in use.
- Cooperative marketing and advertising incentives to capitalize on retailer and manufacturer marketing prowess and to allow them to participate in programs in a way that is compatible with their business image.
- Public relations events such as National Grid’s partnership with the Department of Art, Culture, and Tourism, to cosponsor a public art exhibit featuring recycled refrigerators and educational content on the energy and environmental benefits of recycling.

PROGRAM COST EFFECTIVENESS

As discussed above, the cost effectiveness of appliance programs depends on a number of factors including the type of appliance, the targeted efficiency level and related incremental cost, and whether the program is targeted to the general or specialized populations. The levelized cost of conserved energy (CCE) is easier to generalize for appliance recycling programs, with typical programs administered for a levelized CCE between \$0.02 and \$0.05/kWh.¹⁴ Factors that affect cost-effectiveness include program size and length as well as population density. In general, programs need to achieve a minimum of 30,000 recycled units over three years to be cost-effective. Additionally, levelized CCE is lower in the early years of program implementation when a higher percentage of retired secondary units are not replaced. Long-running programs have shown a gradual decline in cost-effectiveness as the average age of collected refrigerators decreases and the percentage of units being replaced increases.¹⁵ A review of recycling programs suggests that in the early years of a program, most participants will be retiring (and not replacing) secondary units, while programs that have been operating longer will likely need to focus on replacing primary equipment.¹⁶ Thus, education and incentives to promote the purchase of ENERGY STAR certified new equipment may be especially beneficial for long-standing programs.

¹⁰ Consistent with most recycling programs, calculations assume the refrigerator is not replaced.

¹¹ 2012 ENERGY STAR Data Book.

¹² Savings calculated assuming refrigerator is kept in use for an additional 2 years.

¹³ Savings calculated assuming refrigerator is kept in use for an additional 5 years.

¹⁴ ICF International estimates; Cadmus Group, Inc. *Residential Retrofit High Impact Measure Evaluation Report*. Prepared for the California Public Utility Commission Energy Division. (2010).

¹⁵ E-Source, *Refrigerator Recycling Programs: Rounding up the Old Dogs for Easy Energy Savings*. (2006).

¹⁶ E-Source, *Refrigerator Recycling Programs: Rounding up the Old Dogs for Easy Energy Savings*. (2006).

RESOURCES FOR ADDITIONAL INFORMATION

New Appliance Resources:

- ENERGY STAR Certified Products: energystar.gov/products
- ENERGY STAR Product Specification Development: energystar.gov/productdevelopment
- ENERGY STAR Most Efficient energystar.gov/mostefficient
- ENERGY STAR Marketing Resources for Appliance Manufacturers/Retailers: energystar.gov/index.cfm?c=manuf_res.pt_appliances

Appliance Recycling:

- ENERGY STAR Recycling: energystar.gov/recycle
- ENERGY STAR Refrigerator Retirement Savings Calculator: energystar.gov/index.cfm?fuseaction=refrig.calculator

Example Programs from ENERGY STAR Partners

New Appliance Incentive Programs:

- PECO Appliance Incentives, featuring ENERGY STAR Most Efficient: peco.com/Savings/ProgramsandRebates/Residential/Pages/PECOSmartHomeRebates.aspx
- Baltimore Gas and Electric Smart Energy Savers ENERGY STAR Appliance Rebate Program: bgesmartenergy.com/residential/lighting-appliances/appliance-rebates

Appliance Recycling:

- AEP Ohio Appliance Recycling: aepohio.com/save/programs/ApplianceRecycling.aspx
- ComEd Appliance Recycling: comed.com/sites/homesavings/pages/appliancerecycling.aspx
- Southern California Edison Refrigerator & Freezer Recycling Program: sce.com/RebatesandSavings/Residential/_Appliances/RefrigeratorandFreezerRecycling/

Combined Programs:

- Ameren Illinois Refrigerator & Freezer Recycling: actonenergy.com/for-my-home/residential-incentive-programs/refrigerator-freezer-recycling/
- New York Energy Smart Appliance Program: nyserda.ny.gov/en/Page-Sections/Residential/Energy-Efficient-and-ENERGY-STAR-Products/Appliances.aspx

Publications and Other Resources

- American Council for an Energy Efficient Economy (ACEEE), *Compendium of Champions: Chronicling Exemplary Energy Efficiency Programs from Across the U.S.*, Residential Lighting and Appliances Programs: aceee.org/pubs/u081/res-light-app.pdf