Efficiency Maine
Appliance Rebate Program Evaluation
Overall Report

FINAL

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Submitted to:

Efficiency Maine

Submitted by:

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Executive Summary

Efficiency Maine retained NMR Group and Nexant (the evaluation team) to conduct a comprehensive impact and process evaluation of the Appliance Rebate Program. The overarching goal of this evaluation is to assess the effectiveness of the program in achieving its savings goals and learn how Efficiency Maine can refine the Appliance Rebate Program such that it will continue to yield savings in the future. The evaluation was performed for the 2013 Fiscal Year (FY2013), which encompasses the time period from July 1, 2012 to June 30, 2013.

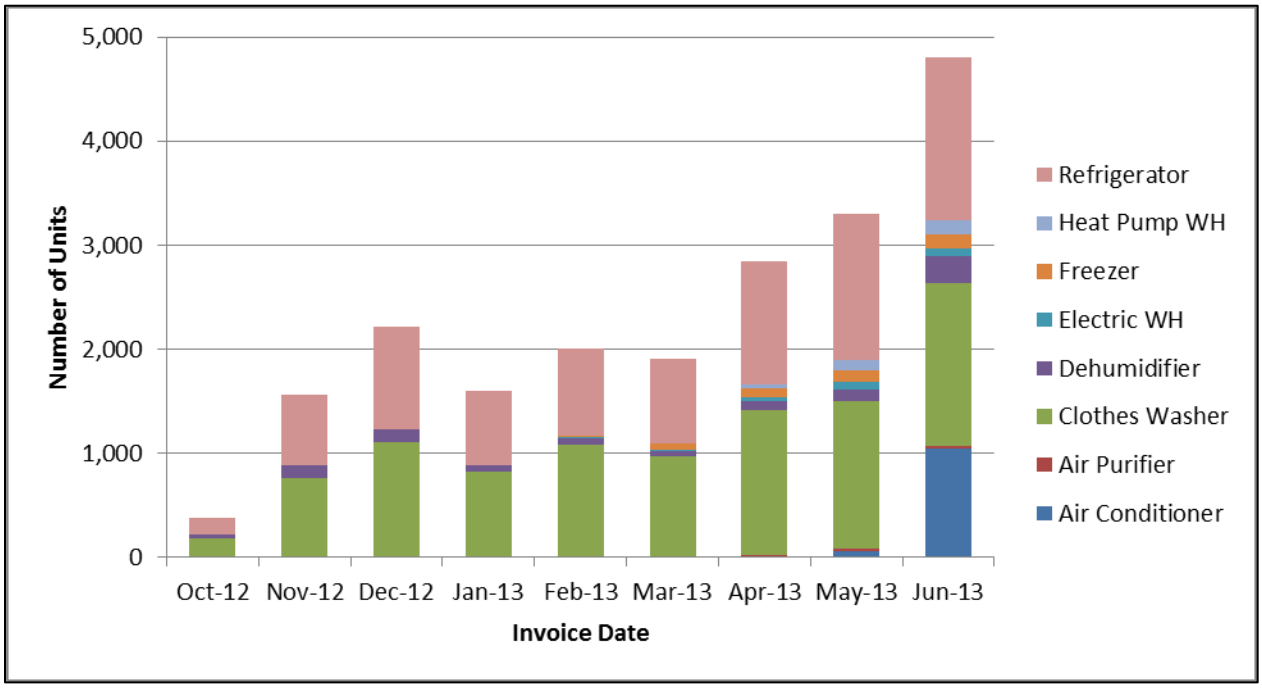
The evaluation team completed a process and impact evaluation, accomplishing the following:

- **Reviewed program assumptions –** including savings assumptions, savings algorithms, program database, and appliance eligibility.
- **Surveyed participants via telephone –** collected data from participants through 382 telephone surveys regarding program attribution, customer decision-making, application characteristics, and demographics.
- **Interviewed store managers via telephone –** collected data from participating store managers through 11 telephone interviews in order to gather feedback regarding participation and satisfaction.
- **Estimated key parameters –** collected measure parameters through 70 on-site visits with metering, and estimated appliance load shapes, usage patterns, and *in situ* adjustments.
- **Verified energy and demand savings** – determined verified (*ex-post*) gross and net energy and demand savings, realization rates, and net-to-gross ratios.
- **Assessed the program results** – calculated cost-effectiveness, first year annual savings, and lifetime savings.

The Appliance Rebate Program reported energy savings for 20,626 appliances purchased during FY2013. In that year, the program initially offered rebates for refrigerators ($50), clothes washers ($50), and dehumidifiers ($25) and later expanded the rebates on January 25, 2013 to include heat pump water heaters ($300), electric resistance water heaters ($150), freezers ($100), air conditioners ($50), and air purifiers ($50). The program also began offering two separate rebate levels for clothes washers ($50 and $100) and increased the refrigerator rebate to $100 on the same date.[1] Figure ES-1 presents monthly program participation by measure according to invoice date, which was dominated by refrigerators and clothes washers.

[1] In early FY2014 (August 2013), the Appliance Rebate Program discontinued rebates for all of the appliances that had been eligible during FY2013, with the exception of the heat pump water heater rebate.

Figure ES-1: FY2013 Program Participation by Measure



Impact Evaluation

In this section we present the key findings of the impact evaluation.

Measure-level Gross Savings

The evaluation team prioritized impact evaluation activities for four measures with the largest *ex-ante* annual kWh and *ex-ante* peak demand savings: Clothes Washers, Dehumidifiers, Heat Pump Water Heaters, and Refrigerators. *Ex-ante* gross savings assumptions, *ex-post* gross savings, and realization rates are listed for each of the four priority measures in Table ES-1. *Ex-ante* assumptions were based on Efficiency Maine's 2013 Residential Technical Reference Manual (TRM) where available; otherwise they were based on program planning assumptions provided by Efficiency Maine.

Table ES-1: *Ex-Ante* Gross Savings Assumptions, *Ex-Post* Estimates, and Realization Rates for Priority Measures

Measure Name	Peak Demand Savings			Annual Energy Savings		
	Ex-Ante (kW)	Ex-Post (kW)	Realization Rate	Ex-Ante (kWh)	Ex-Post (kWh)	Realization Rate
Refrigerator	0.0224	0.0150	66.6%	125	128	102.0%
Clothes Washer	0.0098	0.0550	563.3%	335	372	111.1%
Dehumidifier	0.0597	0.0373	62.4%	268	163	60.7%
Heat Pump Water Heater	0.088	0.1860	211.3%	2,214	2,336	105.5%

The *ex-post* peak demand savings for clothes washers is nearly six times greater than the *ex-ante* value. This difference likely stems in part from the higher energy (kWh) savings compared to *ex-ante* assumptions and in part from differences in the coincidence factor. In particular, it is unclear if the *ex-ante* coincidence factors align properly with the current peak demand window, which is especially important for clothes washers where the load profile shows time-dependent behavior. While the *ex-post* annual energy savings for clothes washers is somewhat higher than the *ex-ante* value (372 kWh vs. 335 kWh), the evaluation team notes that it is substantially higher than the clothes washer energy savings value in the 2014 TRM (162 kWh).

Although the *ex-post* annual savings for dehumidifiers (163 kWh) is approximately 40% lower than the *ex-ante* value (268 kWh), the evaluation team notes that the *ex-post* value is nearly identical to the revised dehumidifier savings value (162 kWh) in the 2014 TRM.The ex-ante measure assumptions for the four non-priority measures (room air conditioner, freezer, room air purifier, and electric resistance water heater) were judged to be reasonable by the evaluation team.

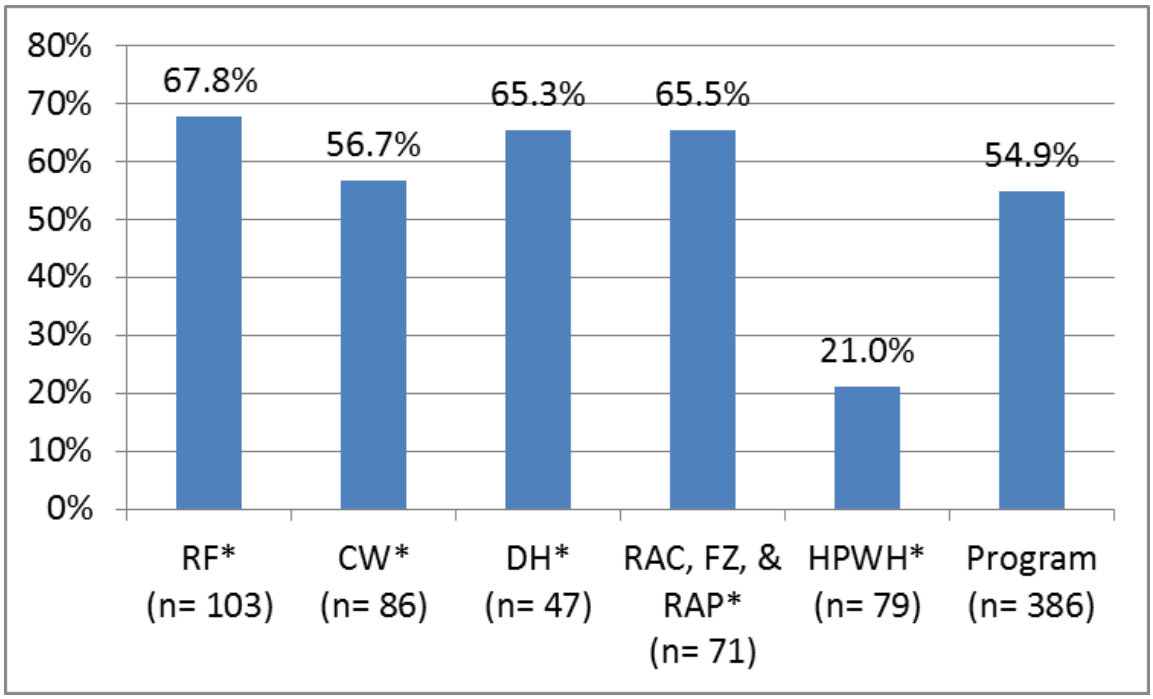
An analysis of clothes washer efficiency levels found that the introduction of the tiered rebates had minimal effect on the proportion of rebates for higher efficiency clothes washers. During the first three months of operation, when only one rebate amount ($50) was offered, 81.0% of all rebates were for high efficiency clothes washers with a modified energy factor (MEF) value of 2.2 or higher. During the last six months of operation when the $100 rebate was also offered the percentage increased slightly to 82.6%. The monthly volume of clothes washer applications was relatively stable during FY2013.

Due to the technological differences influencing energy consumption of heat pump water heaters and electric resistance water heaters, the *ex-post* annual energy savings value for heat pump water heaters does not reflect the onsite metering of water heaters. In addition, the research found that 17 of the 19 on-site heat pump water heater participants formerly heated their water using oil or propane. While it is possible that these participants had already decided to switch to electric water heating and the rebate encouraged an upgrade to a heat pump water heater, these results suggest that the technology may encourage fuel switching among some participants.

Net-to-Gross Ratio

Based on the participant surveys, the evaluation team calculates a freeridership rate of between 56% and 68% for each of the appliance types, with the exception of heat pump water heaters (21%). In addition, we calculate a program-level freeridership rate of 54.9% that accounts for (1) the relative proportion of rebates-to-surveys and (2) the fact that appliances yield different savings values.

Figure ES-2: Participant Freeridership Rate



*RF=Refrigerator; CW=Clothes washer; DH=Dehumidifier; RAC, FZ, & RAP = Room Air conditioner, Freezer, and Room air purifier; HPWH = Heat pump water heater

The freeridership rate is largely driven by the fact that 39% of surveyed participants reported they were not aware of the rebate at the time they purchased their appliance, therefore their freeridership rate equals 100%. Because the program has not been offered consistently, and therefore has not developed a stable presence in the market, it seems reasonable to expect that most people would first learn of the rebate while visiting a store. Some of these participants may not learn of the rebate until after already selecting their appliance model.

In addition, while the program considers incremental costs of high efficiency models when calculating rebate levels, customers tend to consider the overall purchase cost. Because the program offers rebates that are relatively small compared to the purchase price for refrigerators (4%-9%), clothes washers (8%-14%), and dehumidifiers (12%), it seems reasonable that the rebate may have little influence on purchase decisions. In addition, ENERGY STAR appliances have been available in the market for some time and are generally widely available at retail stores. All of these factors may contribute to the high freeridership rate.

Only 18% of heat pump water heater respondents were *not* aware of the rebate when they purchased their water heater, the rebate-to-price ratio for heat pump water heaters is the highest (29%), the rebate ($300) is triple the value of the next highest rebate, and the technology itself is relatively new to the market. All of these factors may contribute to the substantially lower freeridership rate found for heat pump water heaters.

The freeridership findings for Efficiency Maine's program are similar to estimates found in a 2012 evaluation of an appliance rebate program conducted for the New York State Energy Research and Development Authority (NYSERDA). This study found freeridership rates of 62% for refrigerators, 49% for clothes washers, and 40% for freezers.[2] In addition, a California Public Utilities Commission (CPUC) report from 2010 also found high freeridership values for clothes washers – 69% to 71%.[3] It is also worth noting that the NYSERDA report found substantially lower freeridership (15%) for an option where participants purchased three super-efficient appliances and in return received a large rebate ($500).

We estimate that participant spillover represents 3.3% of the programs annual electricity savings. It is important to note that this estimate of participant spillover is conservative because respondents had, at most, a one year window in which to purchase additional energy efficient products. In addition, this estimate does not account for nonparticipant spillover.

Program-level Savings

Program savings are presented in Table ES-2 and Table ES-3. The overall program gross realization rate for energy is 105.9% and the overall program gross realization rate for demand is 196.2%. The overall program net realization rate for energy is 51.2% and the overall program net realization rate for demand is 91.4%. Results are expressed at both the 80% and 90% confidence intervals to satisfy requirements from ISO-NE and Efficiency Maine, respectively.

Table ES-2: Overall Gross Program-level Energy Savings

Stratum	Gross Ex-Post Annual kWh Savings	Net Ex-Post Annual kWh Savings	Relative Precision at 90% Confidence	Relative Precision at 80% Confidence
Refrigerator	1,064,867	374,833	9.3%	7.2%
Clothes Washer	3,454,995	1,599,663	11.7%	9.1%
Dehumidifier	147,410	55,574	3.4%	2.7%
Heat Pump Water Heater	656,332	538,192	0%	0%
Non-Priority Measures	127,621	47,858	0%	0%
OVERALL	**5,451,225**	**2,616,119**	**9.4%**	**7.4%**

[2] NYSERDA American Reinvestment and Recovery Act 2012 Impact Evaluation Report: State Energy Programs. Prepared for NYSERDA. Prepared by The Cadmus Group, Abt SRBI , Beacon Consultants, Energy & Resource Solutions, Navigant Consulting, and NMR Group. April 30, 2012.

[3] Residential Retrofit High Impact Measure Evaluation Report. Prepared For The California Public Utilities Commission, Energy Division. Prepared by The Cadmus Group, Itron, Jai J. Mitchell Analytics, KEMA, PA Consulting Group, and Summit Blue Consulting. February 8, 2010.

Table ES-3: Overall Gross Program-level Demand Savings

Stratum	Gross Ex-Post Summer Peak kW Savings	Net Ex-Post Summer Peak kW Savings	Relative Precision at 90% Confidence	Relative Precision at 80% Confidence
Refrigerator	124.6	43.9	9.3%	7.2%
Clothes Washer	509.9	236.1	11.7%	9.1%
Dehumidifier	33.8	12.7	3.4%	2.7%
Heat Pump Water Heater	52.3	42.9	0%	0%
Non-Priority Measures	22.3	8.4	0%	0%
OVERALL	**742.8**	**343.9**	**9.4%**	**7.4%**

Lifetime savings for the program are presented in Table ES-4.

Table ES-4: Overall Gross Program Lifetime Savings

Stratum	Lifetime Gross kWh Savings	Lifetime Net kWh Savings
Refrigerator	12,778,405	4,536,334
Clothes Washer	38,004,941	17,710,303
Dehumidifier	1,768,921	672,190
Heat Pump Water Heater	6,563,317	5,401,610
Non-Priority Measures	1,290,186	487,690
OVERALL	**60,405,771**	**28,808,127**

Cost-Effectiveness Testing

The evaluation team calculated the cost-effectiveness of the program using the total resource cost (TRC) and program administrator cost (PAC) tests (Table ES-5).

Table ES-5: Overall Program Cost-Effectiveness

Savings Type	TRC Ratio	PAC Ratio
Gross *Ex-Ante* Savings	1.91	2.32
Gross *Ex-Post* Savings	3.41	4.15
Net *Ex-Post* Savings	1.73	1.96

Cost-effectiveness ratios by measure are presented in Table ES-6 and Table ES-7. These ratios do not include program costs, which are added to the costs at the program level. If program costs were distributed to the individual measures, measure level cost-effectiveness would decrease.

Table ES-6: Measure Level TRC Ratios

Measure	Gross *Ex-Ante* TRC	Gross *Ex-Post* TRC	Net *Ex-Post* TRC
Air Conditioner	0.48	0.48	0.20
Air Purifier[1]	N/A	N/A	3.50
Clothes Washer	1.98	4.80	3.15
Dehumidifier	15.24	9.36	3.06
Electric Water Heater	1.42	1.42	1.15
Freezer	9.58	9.58	0.57
Heat Pump Water Heater	2.05	2.36	2.20
Refrigerator	3.58	3.14	0.67

[1] TRC ratios are N/A because the incremental measure cost is $0. Without any costs, the benefit cost ratio cannot be calculated (due to a division by zero error). Normally, incentives paid to participants are not counted as costs for the gross TRC ratio. For the net TRC ratio, incentives paid to freeriders are counted as costs. This provides a non-zero denominator and allows the evaluation team to perform the division.

Table ES-7: Measure Level PAC Ratios

Measure	Gross *Ex-Ante* PAC	Gross *Ex-Post* PAC	Net *Ex-Post* PAC
Air Conditioner	0.48	0.48	0.20
Air Purifier	5.41	5.41	2.29
Clothes Washer	4.05	9.83	4.58
Dehumidifier	12.19	7.49	2.84
Electric Water Heater	1.32	1.32	1.08
Freezer	0.96	0.96	0.39
Heat Pump Water Heater	4.65	5.36	4.41
Refrigerator	1.81	1.59	0.56

Process Evaluation

In this section we present the key findings of the process evaluation.

Program Awareness and Commitment

- The majority of program participants (84%) reported learning about the rebates at the store where they had purchased the appliance, either from the sales staff or point-of-purchase displays. In addition, 70% of participants recalled seeing Efficiency Maine signs that mentioned the rebate at the store where they purchased their new appliance.
- All eleven store managers unanimously agreed that the rebate program was useful as a sales tool. Commitment to selling ENERGY STAR-rated appliances was high among

store managers as well. Nine of the eleven store managers said that selling these products is very important for their store, and ten said that the discontinuation of the program would not affect their commitment to selling ENERGY STAR appliances.

- While they view the program as useful, most store managers reported that their customers exhibit a high degree of demand for ENERGY STAR appliances regardless of the rebates.

Program Satisfaction

- Nearly all program participants are satisfied with the program. In particular, participants are very or somewhat satisfied with the overall program (98%), the rebate amount (94%), and the time it took to receive the rebate (84%). In addition, most participants found the process of completing and submitting the rebate application to be very or somewhat easy (89%). Nearly all participants (92%) who were satisfied with the overall program were either very or somewhat likely to recommend the program to others.
- Nearly all eleven store managers reported being satisfied with the overall program as well. However, most respondents would prefer if the program were consistently offered. Some managers mentioned that rebates for point-of-sale items like room air conditioners should be eliminated in order to prolong the life of the rebate funding for other appliances. Another store manager suggested that the program introduce a "buy more, save more" structure where a customer purchasing multiple appliances would receive a larger rebate than the sum of the individual rebates.
- All store managers were at least somewhat satisfied with the appliances that were eligible for the program. Most respondents mentioned that dishwashers could be added to the program, while acknowledging that most dishwashers are already ENERGY STAR; other appliances mentioned included clothes dryers.
- Nine store managers were at least somewhat satisfied with the point-of-purchase (POP) materials. The most commonly-cited suggestion for improving the POP materials was to revise the stickers; three respondents mentioned that they leave residue and one said they would not stick. Magnets were suggested by one store manager.
- Satisfaction with the rebate amounts was widespread among store managers as well. However, there were two mentions of a rebate being too low (both refrigerators), and three mentions of a rebate being too high (two for heat pump water heaters, and one with freezers), but overall respondents thought the rebate amounts were appropriate.
- Four of the eleven store managers would recommend offering tiered rebate levels on other appliances besides clothes washers. Two respondents mentioned dishwashers, again pointing out that most dishwashers are already ENERGY STAR, but that some are more efficient than others. One respondent mentioned that the rebate for refrigerators and freezers was often disproportionately high or low given the size of the unit, and that the rebates should be based on size instead.

- All store managers who reported receiving program training were very satisfied. However, it was evident that the process of identifying which clothes washer model was eligible for which rebate tier was cumbersome; four of eleven respondents reported having difficulty.

Purchase Decision

- According to participants, most appliances (85%) replaced an old appliance, varying from 93% for refrigerators to 53% for dehumidifiers. Most of these respondents purchased a new appliance because their old unit was old, not working well, it was time to replace, or it stopped working. Nearly all of the appliances that replaced an existing appliance replaced an appliance that was still functioning.
- Across all participants, the single reason that participants cited most often for purchasing their particular appliance model was its good price, or the fact that it was cheaper than alternatives (21%). However, the most important reason given among heat pump water heater purchasers was that the new unit was energy efficient, uses less energy, or saves energy (25%).

In-Store Experience

- The percentage of participants who spoke with a sales person in the store varies greatly depending on the type of appliance. Participants who purchased refrigerators (72%) and clothes washer (73%) were highest followed by heat pump water heaters (53%) and room air conditioners and dehumidifiers (33% each).
- Sales staff appear to effectively promote the rebates to customers. Most of the participants who spoke to a sales person said that the sales person mentioned the Efficiency Maine rebate. In addition, most of these same participants reported that the sales person had also encouraged them to apply for the rebate. The store manager interviews corroborate these participant results as all eleven managers reported that their sales staff mention the rebates when discussing appliances with customers.
- Sales staff influence the purchase decision for some participants. Twenty-eight percent of all participants reported that the sales person had influenced their purchase decision, although this figure varies by appliance type depending on whether or not the customer spoke with a sales person. Those participants who indicated a sales person influenced their appliance purchase said that the sales person most often mentioned a rebate or money back from Efficiency Maine.

Participation in Other Programs

- The program may serve as an introduction to Efficiency Maine programs for a portion of participants. Eighteen percent of all participants reported participating in another Efficiency Maine program since purchasing their appliance through the Appliance Rebate program. Over one-third of these participants reported having purchased a second

appliance through the Appliance Rebate program. Seventeen percent had participated in the Residential Lighting Program for CFLs or LEDs, and another 16% had participated in the Home Energy Savings Program.

- These participants rated the level of importance that their participation in the Appliance Rebate program had on their decision to participate in other programs, using a scale from zero (not at all important) to ten (extremely important). The majority of these respondents (55%) said participation in the Appliance Rebate program had a high level of importance (7 – 10 rating) on their decision.

Recommendations

Based on the findings of the evaluation, the team recommends that Efficiency Maine consider the following recommendations regarding program tracking and assumptions:

- **Provide greater consistency in data tracking.** The evaluation team observed that manufacturer and model number combinations were not consistent with ENERGY STAR data. Alignment of the ENERGY STAR and tracking database entries will facilitate eligibility verification and allow program administrators to easily match models with other existing qualified products lists in order to extract key characteristics.
- **Provide greater detail in data tracking.** The evaluation team relied on other sources to confirm key characteristics, such as capacity and efficiency factors, of the appliances. Providing this detail in the tracking database will enable program administrators to track participation according to additional metrics, allowing quicker program modifications to adjust to changing market conditions. For example, knowledge of MEF levels for rebated clothes washers may have raised a flag to program administrators that the minimum MEF for the $100 rebate should be raised before it was introduced.
- **Update TRM algorithms with evaluated savings and program averages.** Many of the savings estimates in the 2013 TRM and 2014 TRM were calculated using assumptions from the ENERGY STAR Appliance calculator. Given that program averages are now available, the evaluation team recommends using these parameters to update savings estimates. Several examples include average capacity and average MEF for clothes washers and average energy factor (EF) for heat pump water heaters. In addition, we recommend adopting the evaluated peak demand savings values and annual energy savings values estimated by this evaluation. In particular, note that the dehumidifier savings values should reflect the new ENERGY STAR v3.0 criteria.
- **Assess the appropriate baseline for heat pump water heaters.** Of the 19 on-site heat pump water heater participants, most changed their water heating fuel from oil or propane to electric. Furthermore, heat pump water heater participants were much more likely to mention energy savings or switching fuels as the motivation for their purchase than other appliance rebate participants. However, because the heat pump water heater technology is new to the market, some of these participants may be considered early adopters, and

therefore may differ from future participants. Therefore, we recommend collecting data to assess the appropriate baseline scenario for heat pump water heaters. For example, additional questions could be added to the rebate form to collect data on the customer's prior water heating fuel.

In addition, the evaluation team recommends that Efficiency Maine consider the following recommendations regarding program design:

- **Continue offering rebates for heat pump water heaters, and reintroduce rebates for clothes washers and dehumidifiers.** The net savings benefit-cost ratios exceed 1:1 by a substantial margin for these three appliances, therefore we recommend offering rebates in the event that additional funding becomes available.
- **Offer rebates for clothes dryers.** Two interviewed store managers suggested that rebates could be offered on clothes dryers. In addition, clothes dryers received the ENERGY STAR Emerging Technology award[4] in 2013 and an ENERGY STAR clothes dryer specification[5] is currently under development. Lastly, appliance rebate programs in Massachusetts[6] and Vermont[7] are both offering rebates for clothes dryers, although only a few models from one manufacturer are currently eligible. However, all of these efforts suggest that more high efficiency clothes dryer models will soon become available.
- **Continuously offer the program**. Since its inception in 2009, the Appliance Rebate Program has been offered periodically as funding was available. However, several interviewed store managers indicated that the on-off nature of the program is detrimental to its success. In addition, with a continuous program, customers are more likely to learn of rebates prior to visiting a retail store, which may result in greater influence on their purchase decisions.
- **Provide higher value rebates on a more limited selection of super-efficient models.** One reason for the high freeridership may be the fact that the rebates are not large enough to consistently influence the purchase decision of customers. One way to overcome that may be to offer larger rebates on a limited selection of super-efficient appliances that are justified by the greater savings. For example, consider using the TopTenUSA [8] or ENERGY STAR Most Efficient[9] criteria, which each identify the most efficient clothes washers, among other products. Due to the more limited selection of eligible appliances and consequently lower rebate volume, this approach may help preserve funding so that the program can be continuously offered. Some customers are already purchasing

[4] http://www.energystar.gov/about/awards/awards-archive/2013-emerging-technology-award-advanced-clothes-dryers

[5] http://www.energystar.gov/products/specs/node/117

[6] http://www.masssave.com/residential/offers/clothes-dryer-ma

[7] http://www.efficiencyvermont.com/For-My-Home/ways-to-save-and-rebates/Appliances/Clothes-Dryers/Overview

[8] http://www.toptenusa.org/

[9] http://www.energystar.gov/?c=most_efficient.me_index

appliances with a wide array of efficiency levels although it should be noted that this approach may require greater education of sales staff so that they can correctly identify eligible appliances.

- **Offer bundled rebates for multiple high efficiency appliances.** In this case, the program would offer a single large rebate towards the purchase of multiple high efficiency appliances; the larger value of the rebate may have a greater influence on customer purchase decisions. Evaluation results from NYSERDA indicate that freeridership is substantially lower for a single bundled rebate towards the purchase of multiple super-efficient models than for several individual rebate purchases offered for models meeting minimum ENERGY STAR criteria. For example, a customer could receive a single large rebate for their purchase of an ENERGY STAR Most Efficient clothes washer plus an ENERGY STAR Emerging Technology award clothes dryer.
- **Keep abreast of upcoming changes to federal and ENERGY STAR energy efficiency standards.** New federal efficiency standards will be effective for refrigerators and freezers in September 2014 and for clothes washers, clothes dryers, and water heaters in 2015. In particular, the new Energy Factor requirements for water heaters will effectively require heat pump water heaters for electric storage tanks exceeding 55 gallons in size.[10] In addition, new ENERGY STAR requirements for refrigerators and freezers[11] will be effective in September 2014 and ENERGY STAR is currently developing new specifications for clothes washers[12] and dishwashers.[13] All of these changes may affect the energy savings of higher efficiency appliances, and consequently the cost-effectiveness of offering program rebates.

[10] http://www.appliance-standards.org/national
[11] https://www.energystar.gov/certified-products/detail/457/partners?fuseaction=products_for_partners.showRefrig
[12] http://www.energystar.gov/products/specs/node/405
[13] https://www.energystar.gov/products/specs/residential_dishwasher_specification_version_6_0_pd

1 Introduction

In this section we describe the objectives of the evaluation, provide a description of the program, and discuss the methodology used to conduct the impact and process evaluation.

1.1 Study Objectives

Efficiency Maine retained NMR Group and Nexant (the evaluation team) to conduct a comprehensive impact and process evaluation of the Appliance Rebate Program. The overarching goal of this evaluation is to assess the effectiveness of the program in achieving its savings goals and learn how Efficiency Maine can refine the Appliance Rebate Program such that it will continue to yield savings in the future. The evaluation was performed for the 2013 Fiscal Year (FY2013), which encompasses the time period from July 1, 2012 to June 30, 2013.

The objectives of the process evaluation are to assess program design and delivery, the experience of participating partners and customers, and market trends. The overall goal is to assess how the current program is functioning and whether, and how, the program may need to evolve to continue achieving savings goals in a changing marketplace.

The objectives of the impact evaluation are to measure the gross and net energy savings in order to assess progress towards savings goals. The impact evaluation also seeks to measure the gross and net demand savings to support the bidding of demand resources into the Forward Capacity Market (FCM). In addition, the impact evaluation includes the calculation of cost-effectiveness using updated parameters from the study.

The impact evaluation is designed to meet the Independent System Operator-New England (ISO-NE) requirements in order to assure that the evaluation results will provide the necessary FCM data. To do so, the impact evaluation determined summer peak demand savings that is coincident with the summer peak period defined by ISO-NE.[14] The definition is presented in Table 1-1.

Table 1-1: ISO-NE Demand Resource On-Peak Periods

Energy Period	Months	Times
Winter On Peak	December, January	Non-Holiday Weekdays 5:00 PM to 7:00 PM
Summer On Peak	June, July, August	Non-Holiday Weekdays 1:00 PM to 5:00 PM

All peak demand numbers in this evaluation report refer to summer peak demand savings coinciding with the ISO-NE summer on-peak window.

[14] Based on ISO-NE tariff: http://www.iso-ne.com/regulatory/tariff/sect_1/sect_i.pdf

1.2 Program Description

Efficiency Maine has offered the Appliance Rebate Program during three separate periods beginning in 2009; most recently, the program was offered from October 1, 2012 to June 30, 2013 (the end of FY2013). The program initially offered rebates for only refrigerators, clothes washers, and dehumidifiers in FY2013, and was later expanded on January 25, 2013 to include heat pump water heaters, electric resistance water heaters, freezers, air conditioners, and air purifiers for a total of eight measures.[15, 16] The program offered two separate rebate levels for refrigerators and clothes washers.

Table 1-2 lists the appliances eligible for the program in FY2013, along with the rebate level and the proportion of rebates accounted for.

Table 1-2: FY2013 Program Rebate Information

Product	Rebate Amount	Percent of FY2013 Program Rebates
Clothes washers (tier 1)	$50	24%
Refrigerators (after 1/25/2013)	$100	23%
Clothes washers (tier 2)	$100	21%
Refrigerators (before 1/25/2013)	$50	17%
Room air conditioners	$50	5%
Dehumidifiers	$25	4%
Freezers	$100	2%
Heat pump water heaters	$300	1%
Electric resistance water heaters	$150	1%
Room air purifiers	$50	<1%

[15] The Appliance Rebate Program also offered advanced power strips as part of a pilot program. While the 2013 Efficiency Maine Annual Report included these measures in the total unit counts and program savings, advanced power strips were not included in the program data extracts used for the evaluation and therefore are excluded altogether from this report. This measure accounted for only 20 participants based on Efficiency Maine's records.

[16] In early FY2014 (August 2013), the Appliance Rebate Program discontinued rebates for all of the appliances that had been eligible during FY2013, with the exception of the heat pump water heater rebate. In addition, the program began offering $500 rebates for ductless heat pumps but later transferred the measure to the Home Energy Savings Program (HESP).

Table 1-3 presents *ex-ante* savings for each measure, using savings assumptions in Efficiency Maine's 2013 Residential Technical Reference Manual[17], herein "2013 TRM".[18]

Table 1-3: FY2013 *Ex-Ante* Savings by Measure

Measure Name	# of Units	kW Savings	Summer Peak kW Savings[1]	kWh Savings
Air Conditioner	1,109	8.9	7.4	33,270
Air Purifier	84	10.8	7.2	19,320
Clothes Washer	9,279	500.1	90.5	3,108,465
Dehumidifier	906	65.2	54.1	242,808
Electric Water Heater	213	17.3	1.7	41,748
Freezer	401	8.8	6.1	33,283
Heat Pump Water Heater	281	257.7	24.7	622,134
Refrigerator	8,353	271.5	187.0	1,044,125
TOTAL	**20,626**	**1,140.2**	**378.6**	**5,145,153**

[1] Summer Peak kW savings calculated by applying summer coincidence factor to the kW savings.

[17] Efficiency Maine, Residential Technical Reference Manual v2013.1

[18] Savings values were not available for air purifiers, electric resistance water heaters, and heat pump water heaters in the 2013 TRM. The evaluation team used kWh assumptions provided by Efficiency Maine and kW assumptions from the 2014 TRM.

Figure 1-1 and Figure 1-2 present the relative share of *ex-ante* summer peak kW and annual kWh savings by measure. The majority of energy and demand savings are achieved by refrigerators and clothes washers – approximately 50% of the program peak kW savings are from refrigerators and approximately 60% of the program annual kWh savings. Dehumidifiers and heat pump water heaters also contribute a significant share of peak kW and annual kWh savings.

Figure 1-1 : FY2013 *Ex-Ante* Summer Peak kW Savings Share by Measure

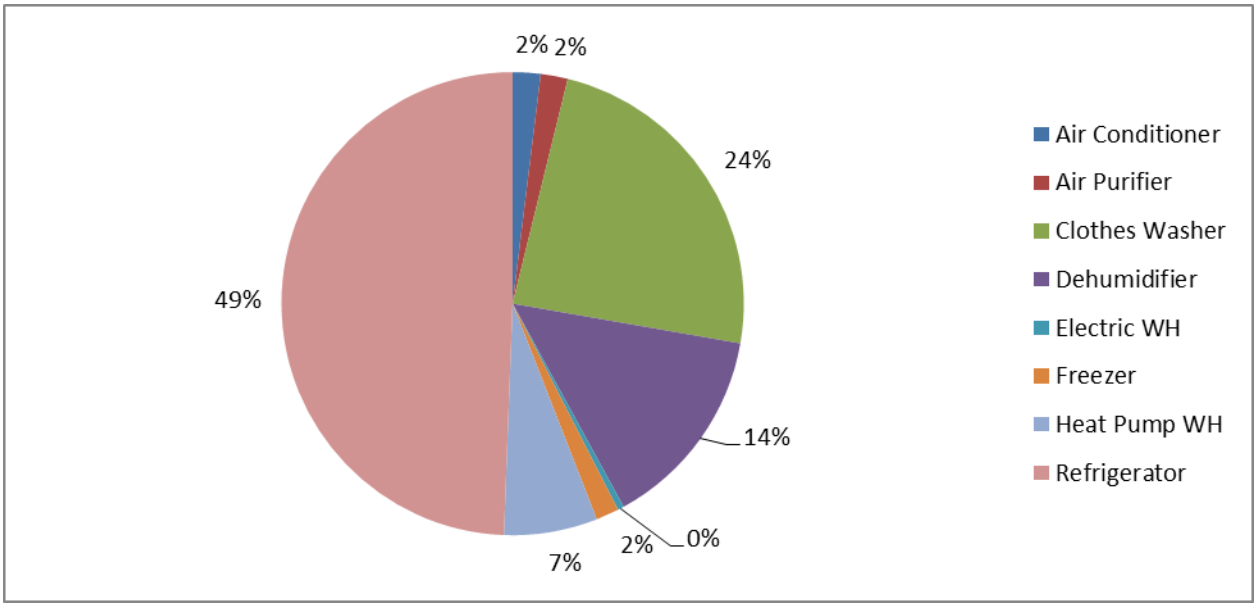


Figure 1-2 : FY2013 *Ex-Ante* Annual kWh Savings Share by Measure

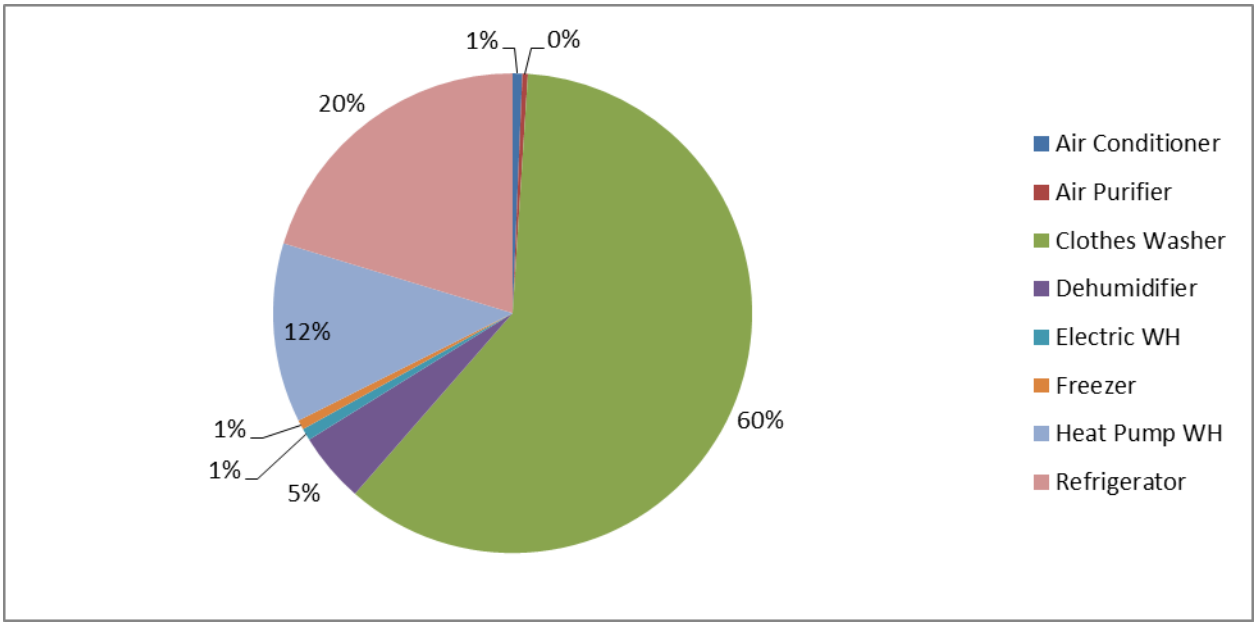


Figure 1-3 presents the number of units rebated by month of purchase. Refrigerators and clothes washers were strong performers throughout the entirety of the program. Seasonal effects can clearly be observed for air conditioners, where participation increased towards the summer months.

The significant decrease in number of units shown for June does not reflect a decrease in activity; rather it is caused by the administrative lag between when a customer purchases an appliance and when the rebate application is approved. During FY2013, the average administrative lag was approximately 32 days. Many appliances purchased in June and even some purchased in May were not processed until after June 30, 2013, resulting in a perceived drop-off in participation. In actuality, these applications were processed in FY2014. However, FY2014 rebates are outside the scope of this evaluation and therefore are not shown or discussed in this report.

Figure 1-3: Program Participation by Purchase Month

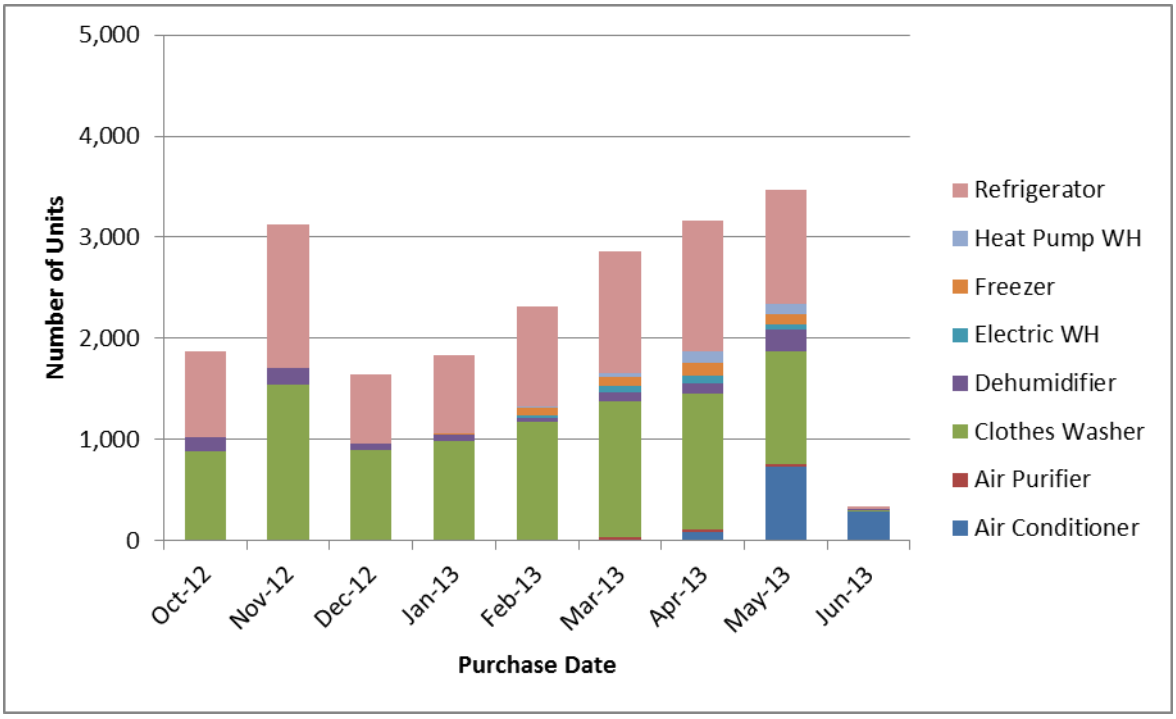


Figure 1-4 presents the number of units rebated by invoice date, which represents the date a rebate was processed by the program administrator. A steady increase in monthly participation from March through June suggests growing success in program marketing and awareness. Contrary to what might be incorrectly inferred in Figure 1-3, this figure shows that the program ramped up activities dramatically in June.

Figure 1-4: Program Participation by Invoice Month

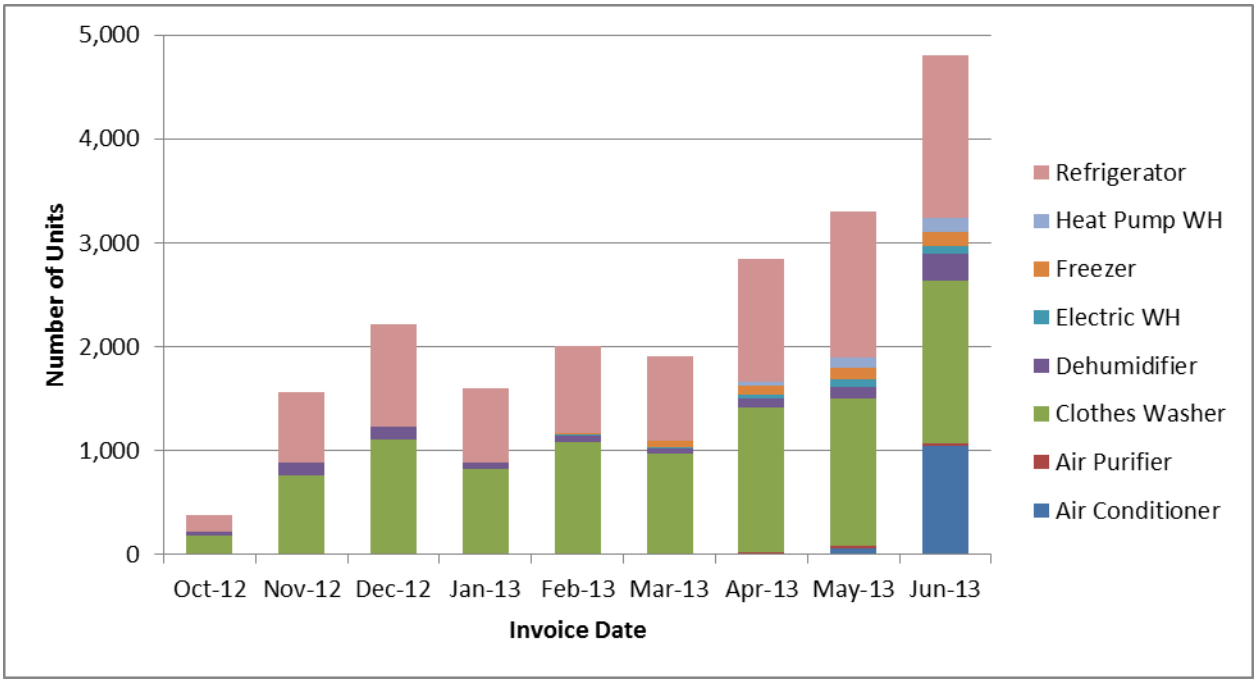


Figure 1-5 presents the program participation share by measure. Refrigerators and clothes washers were by far the most popular measures, representing 85.5% of all measures rebated. Air conditioners and dehumidifiers were the next most popular measures, representing 9.8% of all measures rebated.

Figure 1-5: Program Participation Share by Measure

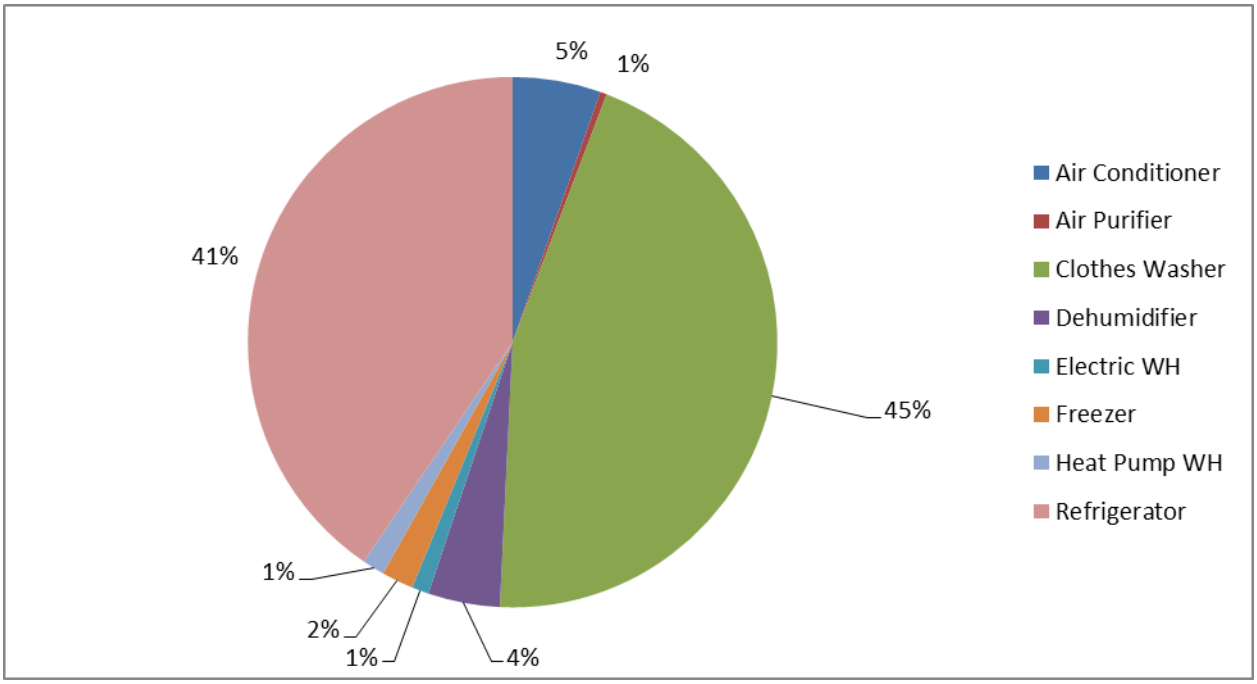
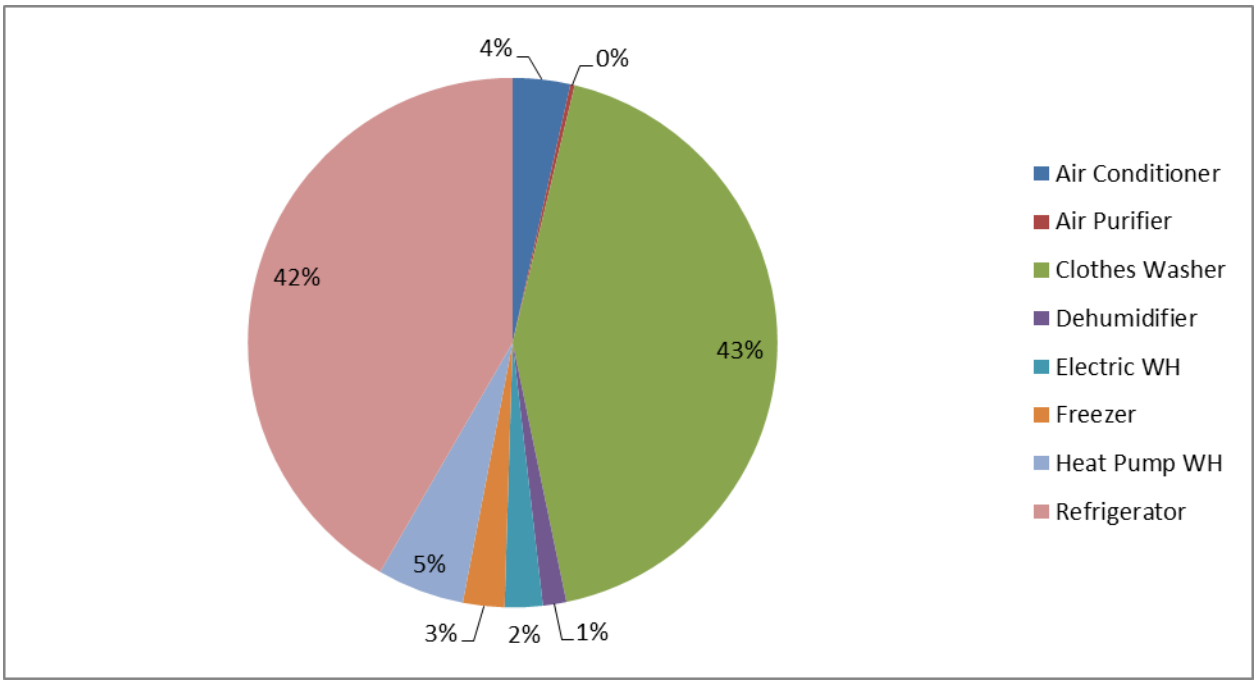


Figure 1-6 displays the share of the total dollar value of program rebates by measure. The distribution is largely similar to the program participation share by measure. The two major differences are for heat pump water heaters and dehumidifiers. Whereas heat pump water heaters make up only 1% of program participants, they represent 5% of the total program rebate value due to the high value of the heat pump water heater rebate ($300). On the other hand, dehumidifiers make up 4% of program participation but only represent 1% of the total dollar value of rebates due to low value of the dehumidifier rebate ($25). The average rebate amount per unit was $76.73.

Figure 1-6: FY2013 Rebate Dollar Value Share by Measure



1.3 Methodology

The overall evaluation work plan can be divided into two components: impact evaluation and process evaluation. The following sections present the methodology for each component.

1.3.1 Impact Evaluation

The evaluation team conducted a comprehensive impact evaluation of Efficiency Maine's Appliance Rebate Program using a variety of data collection and analysis activities to assess gross and net savings. Although all Appliance Rebate Program measures are similar in that they are intended for residences and could be evaluated using the same generic methodology and analysis, the evaluation team employed a stratification approach at the measure level with the goal of yielding more specific and valuable data for individual measures. Using these results, the evaluation team developed program level estimates.

In order to produce statistically valid and useful results at the measure level, the evaluation team prioritized data collection and analysis for four measures with the largest *ex-ante* annual kWh and *ex-ante* peak demand savings: Clothes Washers, Dehumidifiers, Heat Pump Water Heaters, and Refrigerators. These four measures comprised approximately 91.2% of all rebated units during FY2013 and approximately 97.5% of kWh savings. For the purposes of evaluation, the evaluation team considered these four measures as *priority measures*. Relative shares for key metrics are summarized in Table 1-4.

Table 1-4: FY2013 Priority Measure Program Shares

Measure Name	% of Units	% of Program kW Savings	% of Program Peak kW Savings	% of Program kWh Savings
Clothes Washer	45%	44%	24%	60%
Dehumidifier	4%	6%	14%	5%
Heat Pump Water Heater	1%	23%	7%	12%
Refrigerator	40%	24%	49%	20%
All Other	9%	4%	6%	2%
TOTAL[1]	**100%**	**100%**	**100%**	**100%**

[1] Percentages may not sum to 100% due to rounding.

Impact evaluation activities are summarized in Table 1-5. The evaluation team conducted evaluation activities at different levels. Some were performed for all measures whereas others were performed on a sample of participants.

Table 1-5: Summary of Impact Evaluation Activities

Eval. Activity	Target	Description
Measure Review	All Measures	• Review current deemed savings values, assumptions, and algorithms • Develop algorithms for calculating savings • Define critical parameters and assign appropriate values • Review measure useful lives
Phone Survey	Sampled Participants	• Verify accuracy of rebate application data • Recruit for onsite visit and conduct net-to-gross survey
Scheduling Call	Sampled Participants	• Schedule onsite visit • Collect data to facilitate onsite visit
On-site Visit	Sampled Participants	• Confirm accuracy of application review and phone survey data • Collect detailed information on appliance characteristics • Visual verification of installation and persistence of measure installations
Metering	Sampled Participants	• Capture critical usage characteristics through data logging devices
Calculate Gross Savings	Program	• Aggregate project-level savings and calculate realization rate for program • Apply realization rate to the program
Calculate Net Savings	Program	• Estimate NTG ratio from participant survey data • Apply NTG ratio to program
Calculate Cost-Effectiveness	Program	• Calculate cost-effectiveness for the program

1.3.1.1 Measure Review

Because the Appliance Rebate Program relies on deemed savings to produce *ex-ante* savings estimates, the evaluation team reviewed the Efficiency Maine Residential Technical Reference Manual (TRM), which contained algorithms, assumptions, and deemed savings values. Under the direction of Efficiency Maine, which has already developed an updated 2014 version of the TRM, the evaluation team utilized the 2013 TRM when calculating realization rates. However, any recommendations will be made in light of the 2014 TRM updates.

As with most residential measures, the Appliance Rebate Program assumes all measures are new/retrofit/replace on burnout decision criteria. The evaluation team generally agrees that the current minimum allowable efficiency is appropriate as the baseline scenario, but has collected data regarding early replacements as well.

1.3.1.2 Participating Customer Telephone Survey

The evaluation team conducted telephone surveys with program participants, which were designed to collect data for both the impact and process evaluations. For the impact evaluation, the phone surveys were used to determine attribution for each of the priority measures and confirm basic information regarding measures that were rebated. In addition, the interviewers recruited participants for the on-site visit and metering components of the evaluation.

For more details on the phone survey methodology, please see Section 1.3.2.3.

1.3.1.3 Scheduling Call

Appointments were scheduled with participants who agreed to an on-site visit during the telephone surveys. The evaluation team screened recruits by collecting additional details regarding the homeowner's appliances, such as fuel types, presence of other appliances, operation of appliances, and access to appliances. If deemed eligible, on-site visits were scheduled.

1.3.1.4 On-site Visit

On-site visits were targeted at customers who received a rebate for one of the four priority measures as described in Section 1.3.1. The evaluation team designed the on-site sample in accordance with the requirements of ISO-NE M-MVDR to support Efficiency Maine's bid of the program electricity demand savings into the ISO-NE Forward Capacity Market. While M-MVDR Section 7.2 requires "10% relative precision with no less than 80% confidence interval,"[19] for summer peak demand savings, the evaluation team designed the sample to achieve 10% relative precision at a 90% confidence interval to satisfy the sampling requirement for kWh savings.

The final sample design and number of completes for on-sites are presented in Table 1-6.

Table 1-6: On-site Sample Sizes

Measure Name	Minimum Sample Size (80/10 precision)[1]	Target Sample Size	Completed On-site Visits
Clothes Washer	11	18	22
Dehumidifier	6	10	14
Heat Pump Water Heater	3	18	20
Refrigerator	22	24	23[2]
TOTAL	**42**	**70**	**79[3]**

[1] Minimum sample size is based on peak kW savings contribution

[2] The sampling target for refrigerators was short by one due to several cancellations and a limited recruiting pool. However, note that the sampling target still meets the minimum sample size required to meet 80/10 confidence and precision targets. In addition, minimum sample sizes are calculated with an assumed coefficient of variation (CV) of 0.50, which was a conservative estimate compared to the observed CV value.

[3] Actual sample size exceeds the target sample size due to some homeowners having multiple appliances rebated through the program.

[19] The confidence interval is "two-tailed", as described in Section 7.2.3 of the ISO-NE M-MVDR.

The evaluation team collected primary data from the sample of 70 participant homes by conducting impact interviews with homeowners and deploying data loggers during an on-site visit. The interviews contained questions regarding appliance usage and characteristics. Key parameters collected are presented in Table 1-7.

Table 1-7: Onsite Data Collection

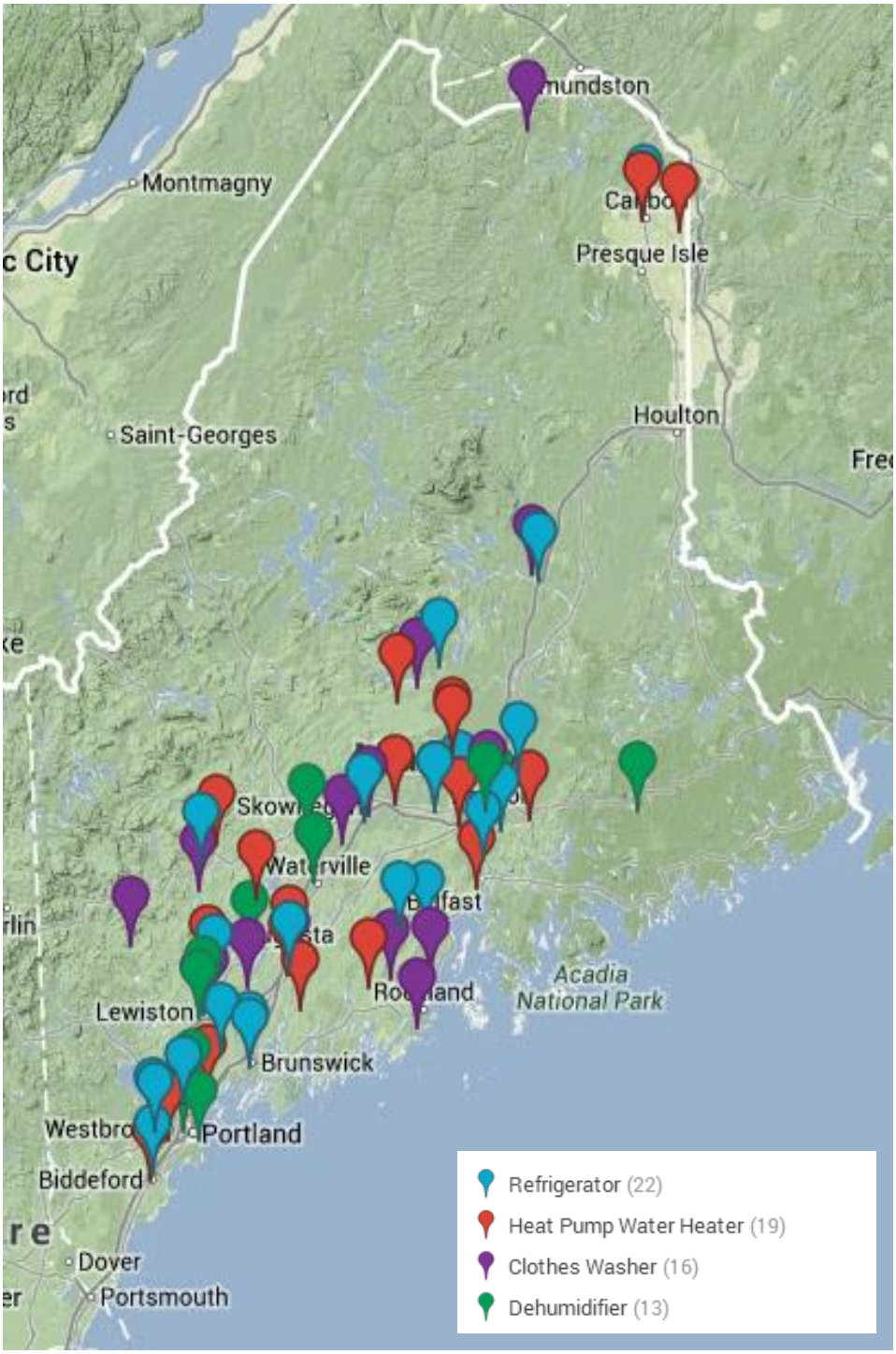
Measure	Key Data Points
All four appliances	• *Verify installation and operation* • *Make and model number* • *Age (year of purchase)*

Clothes Washer	• Capacity of clothes washer and dryer
	• Usage characteristics of clothes washer and dryer, including:
	  • Presence of moisture sensor
	  • Typical spin speed
	• Fuel type for clothes washer and dryer
	• Fuel type, age, efficiency, and temperature set point of hot water

Refrigerator	• Type (Side-by-Side, Top Mount Freezer w/ice, etc.) • Replacement or Additional Refrigerator • Adjusted Volume
Dehumidifier	• Capacity • Average hours of operation (hours/day) • Average annual days of operation (days/year)
Heat Pump Water Heater	• Temperature set point(s) • Water heater current • Supply voltage • Cold water supply temperature

The locations of the on-site visits are shown in Figure 1-7.

Figure 1-7: On-Site Visits



1.3.1.5 Metering

The evaluation team applied more rigorous M&V methods to the four priority measures, following the International Performance Measurement and Verification Protocol (IPMVP) Option A (Retrofit Isolation – Key Parameter Measurement) to ensure conformance to ISO-NE requirements. Metering equipment was selected to satisfy requirements of the ISO-NE Measurement and Verification of Demand Reduction Value (M-MVDR), [20] in particular requirements stated in sections 10 and 11. All metering devices were deployed for a minimum of two weeks using five minute interval data. The evaluation team deployed meters at all 70 homes in four rounds over a period of three and a half months with an average logging duration of 17.6 days. Dates for each round along with measures targeted during those rounds are presented in Table 1-8.

Table 1-8: On-site Visit Dates and Metering Duration

Round	On-site Visit Dates	Average Length of Metering Period (Days)	Completed On-site Visits	Measures
One	9/5/2013 – 9/25/2013	16.8	14	Dehumidifiers, Refrigerators
Two	9/23/2013 – 10/23/2013	15.5	21	Dehumidifiers, Clothes Washers, Refrigerators, Heat Pump Water Heaters
Three	10/21/2013 – 11/8/2013	14.7	15	Dehumidifiers, Clothes Washers, Refrigerators, Heat Pump Water Heaters
Four	11/11/2013 – 12/12/2013	22.8	20	Dehumidifiers, Clothes Washers, Refrigerators, Heat Pump Water Heaters

The evaluation team leveraged on-site visits by conducting metering activities for up to four appliances (where feasible), including the target program appliance (for which the customer received the rebate) and up to three additional appliances in each home (for which the customer may or may not have received a rebate). For this report, the term "rebated appliance" refers to a priority measure that received a rebate. The term "non-program appliance" refers to a priority measure that did not receive a rebate.

The metered data for non-program appliances represents partial participants (i.e., non-program appliances in participant homes), and allowed the extraction of a rich data set from each home. The data collection approach for non-program appliances was identical to that of the rebated appliances, only that the appliance was not purchased with a rebate from Efficiency Maine in FY2013. There was a wide range in age of these appliances, from several months to over 20 years. Metered results were typically used to supplement the development of load shapes and refine the models of rebated appliances, because the evaluation team does not expect efficiency levels to affect usage patterns.

[20] ISO-NE M-MVDR. http://www.iso-ne.com/rules_proceds/isone_mnls/MMVDR/index.html (Accessed July 2013)

Metering approaches for each of the priority measures are presented in the following subsections. Usage of each data point is described in the Gross Savings Analysis sections.

1.3.1.5.1 Refrigerators

The evaluation team deployed four types of meters for each program refrigerator to capture usage parameters for each home, as presented in Table 1-9.

Table 1-9: Refrigerator Metering Equipment

Appliance	Measurement(s)	Manufacturer	Model	Description	Accuracy
Refrigerator	Watts and Watt-Hours	ThinkTank Energy Products	Watts up? PRO	Plug Load Meter	1.50%
	Internal Temperature	Onset	U10-001 or UX100-001	Temperature Data Logger	0.95°F
	Ambient Temperature	Onset	U10-001 or UX100-001	Temperature Data Logger	0.95°F
	# of Door Openings	Onset	U9-002 or UX90-002	Light On/Off Logger	1 min

Counts of metered parameters are shown in Table 1-10. After reviewing the refrigerator data, data collected from two refrigerators were removed from the program sample because the evaluation team discovered that the refrigerators rebated were ineligible for the program, i.e., the refrigerators were not ENERGY STAR certified.

Table 1-10: Refrigerator Parameters Metered

Parameter	Program Rebated Units		Non-Program Units	
	Metered	Usable	Metered	Usable
kWh Consumption	23	21	44	43
Internal Temperature	23	21	42	42
Ambient Temperature	22	20	42	42
Light On/Off	23	21	41	41

1.3.1.5.2 Clothes Washer

The evaluation team deployed a set of meters for each program clothes washer and associated clothes dryer to capture the energy consumption patterns, as presented in Table 1-11.

Table 1-11: Clothes Washer Metering Equipment

Appliance	Measurement(s)	Manufacturer	Model	Description	Accuracy
Clothes Washer	Washer Watts and Watt-Hours	ThinkTank Energy Products	Watts up? PRO	Plug Load Meter	1.50%
	Hot Water Flow Rate	Onset	T-Minol-130	Water Flow Meter	1.50%
Clothes Dryer	Power	Onset	ACT-0750-100 or T-MAG-0400-50	100/50 Amp CT Sensor	1.00%
	Power	Onset	T-WND-3D-240-P	WattNode kWh Transducer	0.45%

Counts of metered parameters for clothes washers are shown in Table 1-12. The intent of the metering activities was to collect metering data for all three system components for each clothes washer system. The evaluation team was unable to collect complete data sets (i.e., metered data for all three system components) for clothes washers systems in many cases, largely due to appliance and electrical panel access issues. In particular, hot water flow measurements were especially difficult due to issues with spacing in laundry rooms as well as leakage.[21]

Table 1-12: Clothes Washer Parameters Metered

Parameter	Program Rebated Units		Non-Program Units	
	Metered	Usable	Metered	Usable
Clothes Washer kWh Consumption	21	20	27	25
Hot Water Flow	8	7	5	5
Clothes Dryer kWh Consumption	13	11	12	9

[21] This is not entirely surprising, as one previous *in-situ* clothes washer study indicated that over 50% of recruits were disqualified because the system layout did not accept the metering equipment. Because of this knowledge, the evaluation team implemented additional criteria for recruiting clothes washer on-site participants to increase metering success. Regardless, some on-site issues that prevented the successful deployment of metering equipment were unable to be screened, reducing overall metering equipment deployment numbers.

1.3.1.5.3 Dehumidifier

The evaluation team deployed two meters for each program dehumidifier to capture the appliance energy consumption patterns, as presented in Table 1-13.

Table 1-13: Dehumidifier Metering Equipment

Appliance	Measurement(s)	Manufacturer	Model	Description	Accuracy
Dehumidifier	Watts and Watt-Hours	ThinkTank Energy Products	Watts up? PRO	Plug Load Meter	1.50%
	Ambient Temperature and RH	Omega	OM-62	Temperature /RH Logger	1°F

Counts of metered parameters for dehumidifiers are shown in Table 1-14. All data collected for rebated dehumidifiers was usable. However, the evaluation team was unable to find many operating non-program dehumidifiers due to the time of year, as well as the relative scarcity of dehumidifiers in homes.

Table 1-14: Dehumidifier Parameters Metered

Parameter	Program Rebated Units		Non-Program Units	
	Metered	Usable	Metered	Usable
Dehumidifier kWh Consumption	11	11	4	2
Ambient Temperature and RH	11	11	4	2

1.3.1.5.4 Heat Pump Water Heater

The evaluation team deployed a set of loggers to capture the energy consumption patterns for program heat pump water heaters, as presented in Table 1-15.

Table 1-15: Heat Pump Water Heater Equipment

Appliance	Measurement(s)	Manufacturer	Model	Description	Accuracy
Electric Water Heater	Power	Onset	ACT-0750-100 or T-MAG-0400-50	100/50 Amp CT Sensor	1.00%
	Power	Onset	T-WND-3D-240-P	WattNode kWh Transducer	0.45%

Counts of metered parameters for heat pump water heaters are shown in Table 1-16. All data collected was usable for heat pump water heaters. For non-program water heaters, the evaluation team metered electric resistance water heaters only. Because electric water heating is not common in Maine, the team metered few non-program water heaters.

Table 1-16: Heat Pump Water Heater Parameters Metered

Parameter	Program Rebated Units		Non-Program Units	
	Metered	Usable	Metered	Usable
Heat Pump Water Heater kWh Consumption	19	19	2	2

1.3.2 Process Evaluation

The evaluation team conducted a comprehensive process evaluation of Efficiency Maine's Appliance Rebate Program including telephone interviews with program staff and participating retail store managers, as well as telephone surveys with participating customers.

1.3.2.1 Program Staff Interviews

The evaluation team conducted two in-depth telephone interviews with the Efficiency Maine program manager and the field implementation contractor Applied Proactive Technologies (APT). The goal of these interviews was to gain an understanding regarding program design, operation, and performance.

1.3.2.2 Participating Retail Store Manager Interviews

The evaluation team conducted eleven in-depth telephone interviews with appliance retail store managers who participated in the program. Six of the interviewees worked for large, national retailers, while the remaining five were with retailers operating only in Maine.

The interviews included open-ended questions to provide store managers the opportunity to offer unprompted feedback on the appliance program. Issues that were addressed in the interviews included:

- Effect of the program on stocking, pricing, and display practices for ENERGY STAR models
- Use of the program as a sales tool and changes in products or promotional activity due to the program
- Perception of customer demand for energy efficient models, and their motivations
- Display of ENERGY STAR point-of-purchase materials
- Effect of tiered incentive levels and changes in rebate levels
- Satisfaction with the program
- Satisfaction with the mix of incentivized products and suggestions for new products
- Adequacy of program training and support
- The degree to which retailers independently promote energy efficient appliances

- Commitment to the ENERGY STAR initiative after the rebates were discontinued, and obstacles that may limit their commitment

The interviews were conducted between October 1 and October 18, 2013 and lasted an average of 33 minutes each (Table 1-17). Interviewed store managers were from retail stores located from South Portland to Houlton, Maine. The average duration of employment among interview respondents was 14 years, suggesting a high level of experience. Respondent job titles included Appliance Department Manager, Assistant Manager, Store Manager, and Owner.

Table 1-17: Store Manager Interview Details

Category	Detail
Number of respondents	11
Number of respondents from national chains[i]	6
Average interview duration	33 minutes
Average duration of respondents' employment	14 years

[i] Lowe's, Home Depot, or Sears.

Interview respondents were recruited from among the most active participating retailers. Forty-eight of the 233 retailer locations (21%) that participated accounted for 90% of rebates; interview respondents were recruited from among these 48 locations. NMR targeted ten retailers for interviews; ultimately, eleven interviews were completed. These eleven retail locations accounted for 3,393 individual rebates, or about 16% of all program rebates in FY2013.

Three large, national retailers—Lowe's, Home Depot, and Sears—each accounted for about one-fifth of rebates in FY2013. Therefore, each of these retailers was assigned two out of the ten interviews in the sampling plan. Agren Appliance accounted for 6% of rebates, and was assigned one interview in the sampling plan. The remaining three interviews were assigned to smaller, independent retailers (Table 1-18).

It is important to note that the opinions expressed by the local store managers from a national chain may not necessarily represent the opinions of corporate staff who often have input into many decisions at local stores.

Table 1-18: Store Manager Interview Sampling Plan

Category	Number of Locations	Percent of Rebates	Interviews Targeted	Interviews Completed
Lowe's	10	22%	2	2
Home Depot	10	19%	2	2
Sears	10	18%	2	2
Agren Appliance	5	6%	1	2
High Volume Independent Retailers	13	24%	3	3
Sample Total	*48*	*90%*	*10*	*11*
Low Volume Retailers (not in sample)	185	10%	0	0

1.3.2.3 Participating Customer Telephone Surveys

In order to gather data from participants regarding program experience and impacts, the evaluation team conducted Computer Assisted Telephone Interview (CATI) surveys with 382 customers who participated in the appliance program during FY2013. The contact information from the sample was derived from the program tracking database. The survey served as the primary vehicle for recruiting volunteers for the onsite visits. Because the onsite visits targeted the four priority measures (clothes washers, heat pump water heaters, refrigerators and dehumidifiers), the participant survey also targeted these products in order to ensure that a sufficient pool of onsite volunteers was available. We also sub-stratified the clothes washer and refrigerator samples in order to capture a representative sample of units incented at different rebate levels.

In addition, 70 surveys were allocated for participants who purchased other program-eligible products (freezers, room air conditioners and room air purifiers) that were *not* included in the onsite sample. Of these 70 surveys, 48 were for room air conditioners, 18 were for freezers, and 4 were for room air purifiers. Based on discussions with Efficiency Maine at the evaluation kickoff meeting, we excluded advanced power strips and high-efficiency electric resistance water heaters from the sample.

The surveys averaged 13.3 minutes in length and were conducted between August 22 and September 17, 2013. As illustrated in Table 1-19, the sample precision at the 90% confidence level is ±5.4% overall, and is less than ±10% for each appliance group, except for dehumidifiers.

Table 1-19: Appliance Participant Survey Sample Design

Measure	Program Rebates in FY2013		Participant Surveys		Precision at the 90% Confidence Level	Program Weight
	Number	Percent	Number	Percent		
Clothes Washers	9,279	45.5%	80	20.9%	±9.2%	2.17
Refrigerators	8,353	40.9%	104	27.2%	±8.1%	1.50
Dehumidifiers	906	4.4%	48	12.6%	±11.7%	0.35
Heat Pump Water Heaters	281	1.4%	80	20.9%	±7.8%	0.07
Freezers, Room Air Conditioners, and Room Air Purifiers	1,594	7.8%	70	18.3%	±9.7%	0.43
Total	*20,413*	*100%*	*382*	*100%*	*±5.4%*	*n/a*

Because heat pump water heaters, and to a lesser extent dehumidifiers, were of particular interest to the evaluation, these products were oversampled in the participant survey. Therefore, in order to produce results that reflect the entire program, the survey data was weighted to estimate the overall program results using the weights listed in the last column of Table 1-19. The weights are calculated by dividing the percent of program rebates by the percent of surveys.

The surveys gathered information from participants regarding their awareness of the program and tiered rebates, level of satisfaction with various components of the program, their experience in the retail store, reasons for purchasing their chosen model, the influence of the program on their appliance purchase decision (free ridership), subsequent program participation and purchases of energy efficient equipment (spillover), as well as their demographic characteristics. We also administered a battery of questions in order to identify low-income customers. Lastly, for those customers who received six free CFLs though the program, the survey collected information on CFL installation, satisfaction, and spillover.

Because a small portion of program participants (about 5%) purchased multiple appliances through the program during FY2013, the 15 survey respondents who purchased multiple appliances were asked the full battery of questions about their primary appliance and a shorter battery of questions about the secondary appliance.

2 Impact Evaluation

The impact evaluation section of this report consists of the gross savings analysis and net savings analysis, followed by a summary of savings at the program level and finally the cost-effectiveness analysis based on program level savings.

2.1 Gross Savings Analysis

The evaluation team produced *ex-post* gross savings for the four priority measures with the assistance of metering data collected during on-site visits. The first four subsections contain individual write-ups for each of the priority measures, as the analysis process is tailored to each measure. The last subsection contains gross savings results for all other measures.

2.1.1 Refrigerators

The evaluation team reviewed the program database and found a total of 8,353 refrigerators incented by the program during FY2013. Two rebates levels were offered for refrigerators during FY2013 – customers received rebates of $50 for 3,521 refrigerators and rebates of $100 for 4,832 refrigerators. Because the two rebate levels were not offered simultaneously and did not have different eligibility requirements other than purchase date, the evaluation team made no distinction between the two rebate levels with the understanding that rebate levels did not influence the efficiency levels of rebated refrigerators.

Figure 2-1 and Figure 2-2 present the count of refrigerator rebates by purchase date and invoice date, respectively. While only refrigerators purchased before January 25, 2013 were rebated at the $50 level, applications for those rebates continued to be processed in June, demonstrating that a significant amount of time elapses between the purchase date and invoice date in some cases.

Figure 2-1: Refrigerator Counts by Rebate and Purchase Date

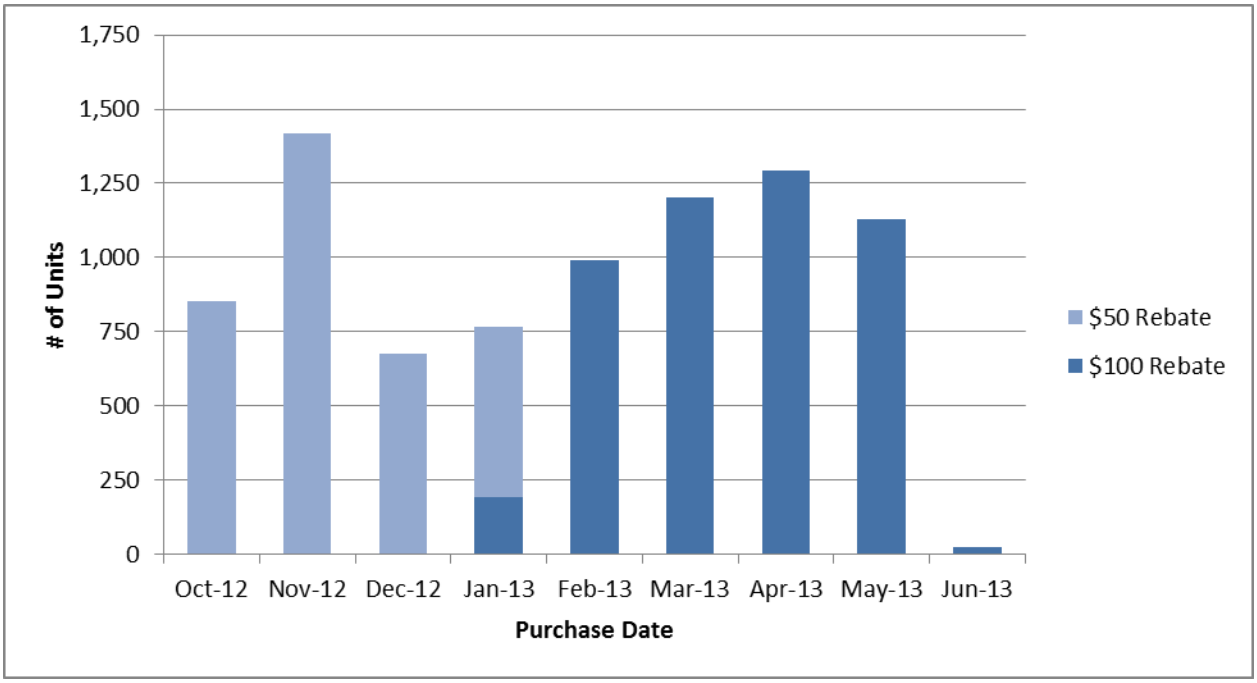
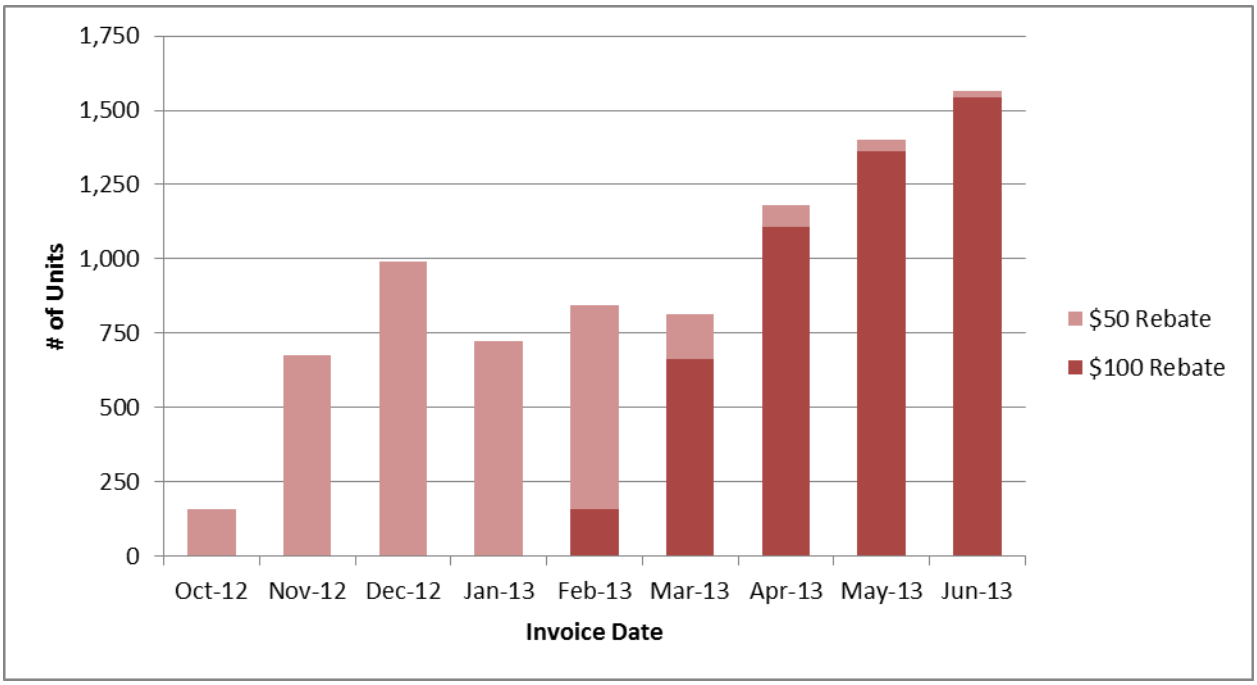
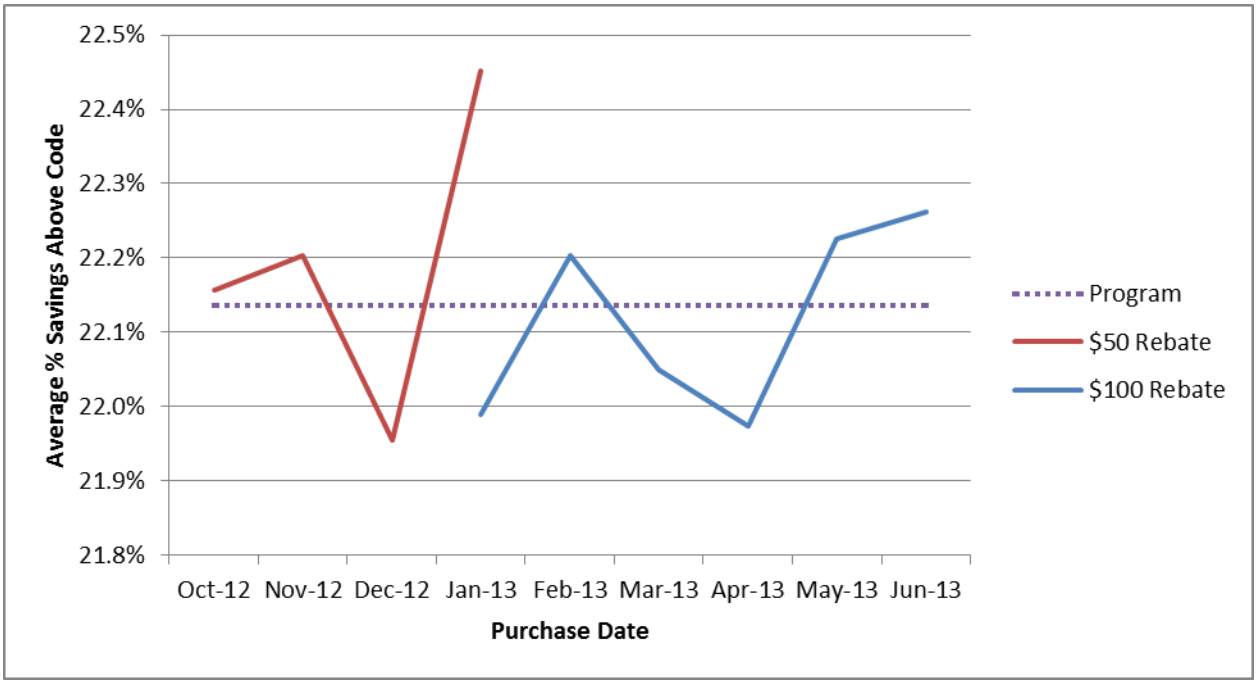


Figure 2-2: Refrigerator Counts by Rebate and Invoice Date



While the larger rebate amount may have encouraged more participation, it does not appear to have caused an increase in the efficiency of refrigerators rebated. While it might be expected that with a larger rebate, customers may be more willing to purchase higher cost, higher efficiency refrigerators, the data suggests that there is no significant effect, as shown in Figure 2-3.

Figure 2-3: Refrigerator Average Rated Savings Compared to Code by Rebate



Efficiency Maine utilized the 2013 TRM assumptions to assign *ex-ante* savings values to refrigerators. The unit kWh savings value is sourced from the ENERGY STAR Appliance Calculator[22] accessed in 2012[23], using the Bottom Mounted Freezer (Auto Defrost) unit as a proxy for all units. The baseline unit is a refrigerator that is minimally compliant with the federal code defined by the National Appliance Energy Conservation Act (NAECA). The unit kW savings value is calculated using a load reduction factor sourced from a previous end-use metering study performed in Maine. The coincidence factor is sourced from the same study. Savings values are presented in Table 2-1.

Table 2-1: Refrigerator *Ex-Ante* Savings Assumptions

Measure Name	Unit kW Savings	Unit Peak kW Savings	Unit kWh Savings
Refrigerator	0.0325	0.0224	125

[22] United States Environmental Protection Agency (USEPA), ENERGY STAR Appliance Savings Calculator, August 2012, http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/appliance_calculator.xlsx

[23] As of the most recent update in January 2014, the ENERGY STAR Appliance Calculator now shows slightly lower savings, due to the fact that the calculator assumes that ENERGY STAR refrigerators perform 20% better than federal standard, as opposed to 22% figure used in the version accessible in August 2012.

2.1.1.1 Database Review

To confirm eligibility and key characteristics of each refrigerator, the evaluation team reviewed the FY2013 program database to map all manufacturer and model number combinations to the ENERGY STAR certified products list[24] for residential refrigerators, herein called "QPL" or "Qualified Products List". In most cases mapping was possible, but corrections were made to manufacturer names and/or model numbers for about 4% of the records to enable proper mapping. In a small number of cases (<1.3%), mapping to the QPL was not possible and models were identified as either certified at a previous time or never certified. A detailed breakdown of corrections made to manufacturer and/or model numbers can be found in Appendix B.1.

Based on the database review, the evaluation team identified three classes of refrigerator records.

- Refrigerators that were mapped to the QPL, with or without correction, were classified as *eligible ES refrigerators*.
- Refrigerators that were ENERGY STAR certified previously but are no longer on the QPL are classified as *former ES refrigerators*. The majority of the refrigerators falling under this category are older models no longer in production, leading the evaluation team to believe that some participants purchased refurbished refrigerators as opposed to new refrigerators. Because complete and reliable data for adjusted volume and rated kWh was not available for these refrigerators, the evaluation team did not include this class of refrigerators when calculating averages. However, since federal standards have not changed since 2001, these refrigerators received full credit for savings.
- Refrigerators that were never certified are classified as *ineligible refrigerators* and were not credited with any savings.

Refrigerators by class are presented in Table 2-2.

Table 2-2: Refrigerator Models by Classification

Classification	Quantity	% of Total
Eligible ES Refrigerators	8,250	98.8%
Former ES Refrigerators	55	0.7%
Ineligible Refrigerators	48	0.6%
TOTAL[1]	**8,353**	**100%**

[1] Percentage totals may not sum to 100% due to rounding

[24] United States Environmental Protection Agency (USEPA), ENERGY STAR Certified Residential Refrigerator List, January 2014. http://www.energystar.gov/productfinder/download/certified-residential-refrigerators/

2.1.1.2 Energy Savings

The evaluation team calculated the *ex-post* kWh savings for refrigerators by the following:

$$\Delta kWh = (kWh_{Federal\ Standard} - kWh_{Rated}) \times ISA$$

Where:

$kWh_{Federal\ Standard}$ = Maximum annual kWh consumption of refrigerator based on federal code

kWh_{Rated} = Rated annual kWh consumption of refrigerator, also labeled as Energy Guide kWh.

ISA = *In-situ* adjustment factor to account for "real world" conditions

One major difference in savings estimation from *ex-ante* to *ex-post* is that the evaluation team used actual rated energy consumption and maximum energy consumption allowable by the federal standard of each refrigerator as opposed to assuming that each refrigerator is a bottom-mounted freezer with automatic defrost and an ice maker. The other major difference is that the evaluation team used metered data to calculate an *in situ* adjustment.

The evaluation team contemplated using an in-service rate factor to account for refrigerators that were rebated but not installed and operating. However, based on the results of the participant survey, the evaluation team determined an adjustment was not needed. Of the 110 participants surveyed who received a rebate for a refrigerator, only three responded that the new refrigerator was not operating at the time of the survey, and two of the three respondents indicated that the refrigerator would be installed within the month. The last respondent did not give a timeframe for when the refrigerator would be installed. A breakdown of in-service status by rebate amount is presented in Table 2-3.

Table 2-3: Refrigerator In-Service Survey

Response	$50 Rebate Refrigerators	$100 Rebate Refrigerators	All Refrigerators
Unit is operating	42	63	105
Unit is not operating	3	0	3
…If not, unit will be operating in 1 month	2	0	2
No Response	1	1	2
TOTAL RESPONDENTS	**46**	**64**	**110**

Using data provided in the QPL, the evaluation team identified kWh_{Rated} and calculated $kWh_{Federal\ Standard}$ for each refrigerator with the appropriate NAECA formula[25] based on refrigerator configuration and adjusted volume. The difference between these two values is referred to as the "sticker" savings, reflecting the fact that the savings are based on consumption estimates from manufacturer or lab testing procedures and that "real world" conditions have not been taken into account.

$$Sticker\ kWh\ Savings = kWh_{Federal\ Standard} - kWh_{Rated}$$

The results for each configuration and for all refrigerators combined are presented in Table 2-4.

Table 2-4: Refrigerator "Sticker" kWh Savings by Configuration

Configuration[1]	Ice Maker	Quantity	Average Federal Standard kWh	Average Rated kWh	Average Sticker kWh Savings
Bottom Freezer	No	2,357	576.62	443.95	132.66
Bottom Freezer	Yes	1,214	698.88	537.31	161.57
Side-by-Side	No	16	647.90	516.09	131.82
Side-by-Side	Yes	9	716.92	557.33	159.59
Single Door Refrigerator	No	24	446.19	355.33	90.86
Single Door Refrigerator-Freezer	No	1,456	452.40	306.00	146.40
Top Freezer	No	3,174	484.01	382.41	101.60
ALL CONFIGURATIONS	**All**	**8,250[2]**	**583.43**	**453.62**	**129.82**

[1] All refrigerators incented by the program were of the auto defrost variety. Refrigerators with manual or partial defrost would be categorized separately according to the NEACA standards.
[2] The total quantity does not include 103 refrigerators that did not map to the QPL.

[25] NAECA formulas are taken from the 2001 update. The equation for bottom mounted freezers with auto defrost and a through-the-door ice maker is taken from the ENERGY STAR Appliance Calculator, as the federal standards do not provide any equation for that particular configuration. Current standards can be observed at the DOE EERE website. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43

The evaluation team derived the *ISA* factor using metered data collected from refrigerators by comparing *actual* kWh consumption with the *rated* kWh consumption. The actual kWh consumption values reflect real world conditions, such as door openings, food in the refrigerator, internal temperature settings, and ambient conditions. The ISA is calculated as a straight average because minimal bias is expected from any uncontrolled refrigerator characteristics.[26] The calculation for the *ISA* factor is as follows:

$$ISA = \frac{1}{n}\sum_{i=1}^{n}\frac{kWh_{Actual}}{kWh_{Rated}}$$

The statistical results for the *ISA* factor are provided in Table 2-5.

Table 2-5: Refrigerator Metering Parameter Estimates

Statistics	ISA
Mean Value (μ)	98.8%
Samples (n)	21
Relative Precision at 90% Confidence	9.3%
Relative Precision at 80% Confidence	7.2%
Coefficient of Variance (Cv)	0.26

The *ISA* factor estimate is 98.8% (±0.071 at 80% confidence), which yields very little change from the sticker savings. Given the rigorous testing procedures required to estimate the rated annual energy consumption of refrigerators, the *ISA* estimate is not surprising.[27] While *in situ* refrigerator metering typically yields higher energy consumption values and therefore *ISA* values above 100% (usually because metering is performed on much older refrigerators for appliance recycling programs), the evaluation team believes that the lower temperature climate of Maine may have contributed slightly to a lower *ISA* value, especially since the metering period overlapped the fall months when outdoor temperatures in Maine were relatively low and thermostat set-points are generally adjusted downward.[28] Lower ambient temperatures allow refrigerators to retain cooler temperatures, thus reducing compressor operation and energy consumption.

[26] Age is a factor that may impact the ISA – however, any refrigerators included in this sample were part of the Appliance Rebate Program and therefore should not have been in operation until October 1, 2012 or later. The maximum age of the refrigerator sample population at the time of the data collection was two years with an average age of 0.74 years.

[27] In 2010, the DOE conducted a large research study to incorporate a usage adjustment factor (UAF) into their testing procedures, presumably improving manufacturer estimates of annual energy consumption. Many older evaluation reports claiming that refrigerators use more energy *in situ* compared to in the lab were conducted prior to the release of this DOE report. See page 7-3 of the Federal Standard Refrigerator Technical Support Document. http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/refrig_nopr_tsd_2010-09-23.pdf

[28] Thermal comfort is typically achieved between 68ºF – 73ºF during the winter and 73ºF – 78ºF during the summer. ASHRAE 55-2010.

Based on measured parameters, the *ex-post* unit kWh savings is calculated as follows:

$$\Delta kWh = (kWh_{Federal\ Standard} - kWh_{Rated}) \times ISA$$

$$\Delta kWh = (583.43 - 453.62) \times 98.8\%$$

$$\Delta kWh = 128.22\ kWh$$

The resultant *ex-post* unit annual kWh savings is very similar to the 2014 TRM value of 125 kWh. The small difference can be attributed to the distribution of refrigerator configurations[29] and percent savings above the federal standard, both of which will change from year to year. The *ex-post* unit kWh savings value is also about 43 to 82 kWh[30] higher than results in a recently published evaluation report in the Pacific Northwest;[31] this difference is mostly due to the use of a "market baseline" rather than federal code baseline. The evaluation team's baseline approach (federal code) is consistent with the ENERGY STAR calculators and the method in which Efficiency Maine has been calculating savings for the Appliance Rebate Program for all measures, therefore a direct comparison is not appropriate.

The market baseline approach considers the fact that customers making a purchase without a rebate may purchase an efficient unit due to the fact that cost and efficiency are not the only factors that customers weigh when making a purchase. However, usage of the market baseline approach also requires the removal of independent net savings analysis, since customer motivation is already built into the baseline assumption. A more appropriate comparison can be made between the Pacific Northwest study results and the net savings of this evaluation report - – and in fact when this is done, the resultant savings are very similar.[32]

[29] The *ex-ante* savings estimate uses the bottom mounted freezer with auto defrost configuration, whereas the population is comprised of a mix of various configurations, e.g., top mounted freezer with manual defrost and single door with auto defrost. Each configuration has a different equation that governs the maximum energy consumption and therefore each configuration has a different savings value. This can also be observed using the ENERGY STAR calculator.

[30] This secondary source provides savings at two efficiency tiers.

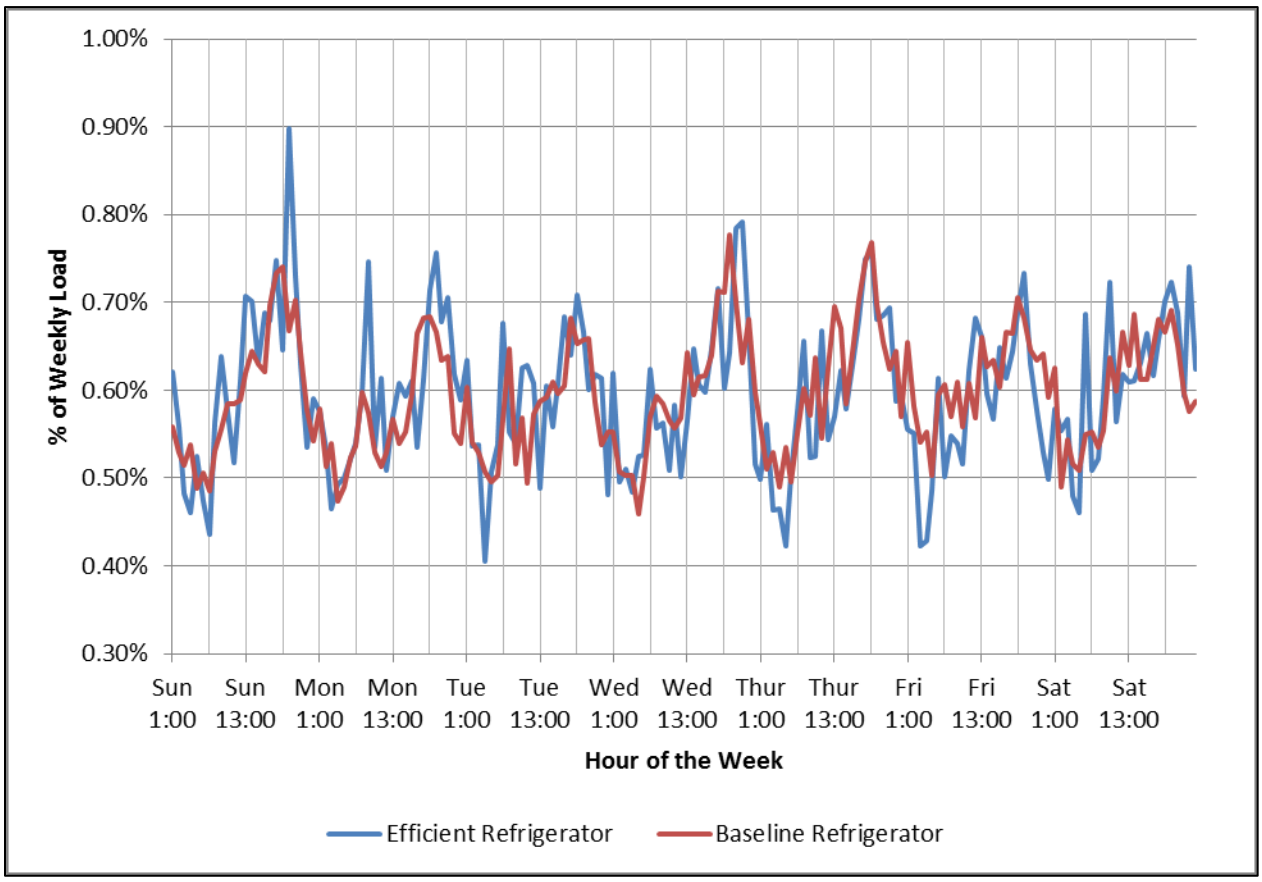
[31] PSE Refrigerator Programs: Impact and Process Evaluation, May 2013. http://rtf.nwcouncil.org/subcommittees/fridgerecycle/meetings/PSE%20Ref%20Impact%20Final_WithERR.pdf

[32] The evaluation team notes that while this comparison is more equivalent, the variability of net-to-gross ratios may cause this comparison to be less reliable.

2.1.1.3 Demand Savings

The evaluation team developed weekly load shapes for all metered refrigerators, including both rebated refrigerators and non-program refrigerators. The evaluation team does not believe that usage profiles are affected by a more or less efficient refrigerator and therefore deemed all collected data useful to the analysis.[33] The evaluation team also believes that usage profiles for refrigerators generally do not change from week to week (i.e., refrigerator usage patterns are not weather dependent), therefore a 168 hour load profile can be used to estimate an 8,760 hour load shape. The weekly load profile from metered refrigerators is presented in Figure 2-4.

Figure 2-4: Refrigerator Weekly Load Profile



The evaluation team calculated summer on-peak demand savings by first applying the estimated hourly load profile to the annual energy savings to determine average hourly demand savings and then isolating the ISO-NE summer on-peak hours. The *ex-post* unit peak demand savings is calculated to be 0.0150 kW.

The resultant *ex-post* demand savings is approximately 70% of the *ex-ante* and the 2014 TRM estimates, both of which use a load reduction factor from a 1988 end-use metering project to convert annual energy savings into a demand savings. The evaluation team can infer from the

[33] This is also confirmed by the fact that each individual load profile yields nearly identical demand savings.

data that the new load shapes are smoother with fewer peaks compared to the metering study from 1988. This may be a result of newer refrigerators having smarter controls and cycling technology compared to 25 years ago.

2.1.1.4 Decision Type Analysis

The evaluation team was able to interview 21 participants who received a rebate for a refrigerator and were able to estimate the age of their previous refrigerator. Because most of these refrigerators were removed from the property after the installation of the new rebated refrigerator, the evaluation team relied on self-reports from the participant. Average ages are presented in Table 2-6.

Table 2-6: Previous Refrigerator Average Life

Previous Refrigerator Age[1]	Average Age (years)	Respondents (n)
6 Years Old or Less	5.7	3
Less than 12 Years Old but More than 6 Years Old	10.8	5
More than 12 Years Old	18.5	13
Could not Recall	N/A	3
ALL PREVIOUS REFRIGERATORS[2]	**14.8**	**21**

[1] Twelve years is used as the cut-off because the effective useful life for refrigerators is 12 years.
[2] Does not include the 3 non-responses in the total.

Given that refrigerators have a 12 year effective useful life (according to the 2013 TRM), refrigerators that are over 12 years old are identified as refrigerators exceeding useful life. Therefore, rebated refrigerators replacing refrigerators exceeding useful life represent a new or replacement scenario. The evaluation team identified refrigerators that are 12 years old or less as refrigerators with remaining useful life; these could be considered as early replacement scenarios.

Based on these 21 interview responses, approximately 38% of refrigerators could be considered early replacement. With a more conservative estimate that defines early replacement as a situation where the replaced unit still has more than half its effective useful life remaining, this figure drops to 14%.

2.1.1.5 Savings Summary

Through metering and analysis activities, the evaluation team calculated unit *ex-post* savings values, presented in Table 2-7.

Table 2-7: Refrigerator *Ex-Post* Savings Assumptions

Measure Name	Unit Peak kW Savings	Unit kWh Savings
Refrigerator	0.0150	128.22

To calculate the total *ex-post* savings for refrigerators, the evaluation team applied the unit *ex-post* savings to only eligible refrigerators. Realization rates are expressed as the gross *ex-post* savings divided by the gross *ex-ante* savings. A summary of results for refrigerators is presented in Table 2-8.

Table 2-8: Refrigerator Savings Summary

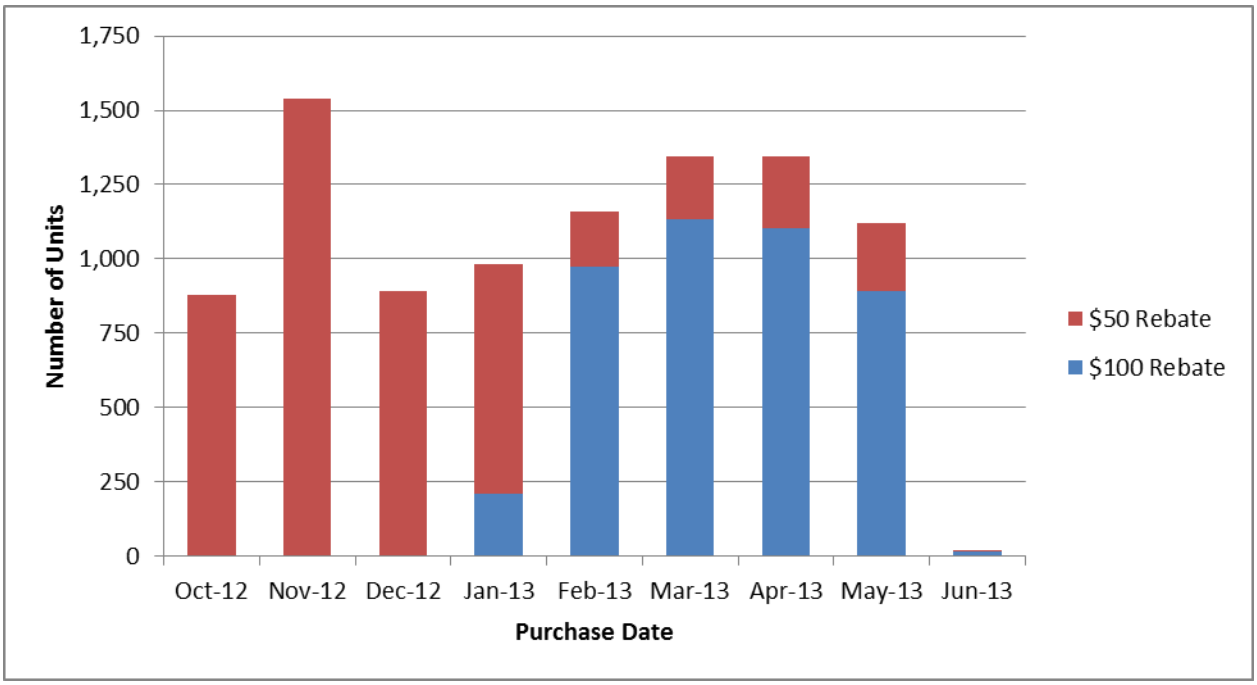
Savings Type	Peak kW Savings	kWh Savings
# of Units Rebated	8,353	8,353
Gross *Ex-Ante* Savings	187.0	1,044,125
# of Units Eligible	8,305	8,305
Gross *Ex-Post* Savings	124.6	1,064,873
Realization Rate	66.6%	102.0%
Relative Precision at 90% Confidence	9.3%	9.3%
Relative Precision at 80% Confidence	7.2%	7.2%
Coefficient of Variance (Cv)	0.26	0.26

2.1.2 Clothes Washers

The evaluation team reviewed the program database and found a total of 9,279 clothes washers incented by the program in FY2013. Initially, the program offered a $50 rebate for a standard ENERGY STAR clothes washer; beginning in January 2014, the program offered an additional $50 rebate for an ENERGY STAR clothes washer with a modified energy factor (MEF) of 2.2 or above. During FY2013, 4,324 clothes washers received $100 rebates and 4,955 clothes washers received $50 rebates.

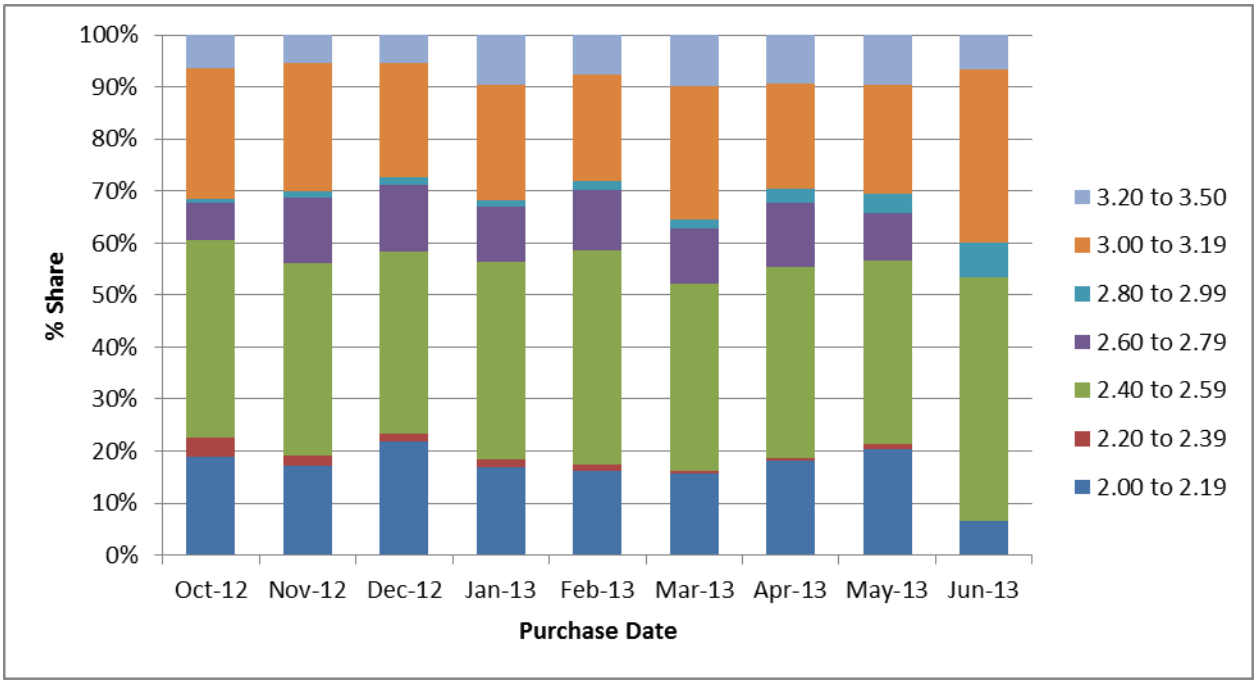
Monthly counts by rebate amount are presented in Figure 2-5 based on purchase date. At the start of the FY2013 program, only $50 rebates were offered for all clothes washers. When the program introduced the $100 rebate in January 2014, customers immediately took advantage. By February, the $100 rebates accounted for over 80% of clothes washer rebates. The sudden decrease in clothes washers with purchase dates in June is attributed to the delay between purchase date of the appliance and invoice date of the rebate application, as described in Section 1.2.

Figure 2-5: Clothes Washer Counts by Rebate Amount



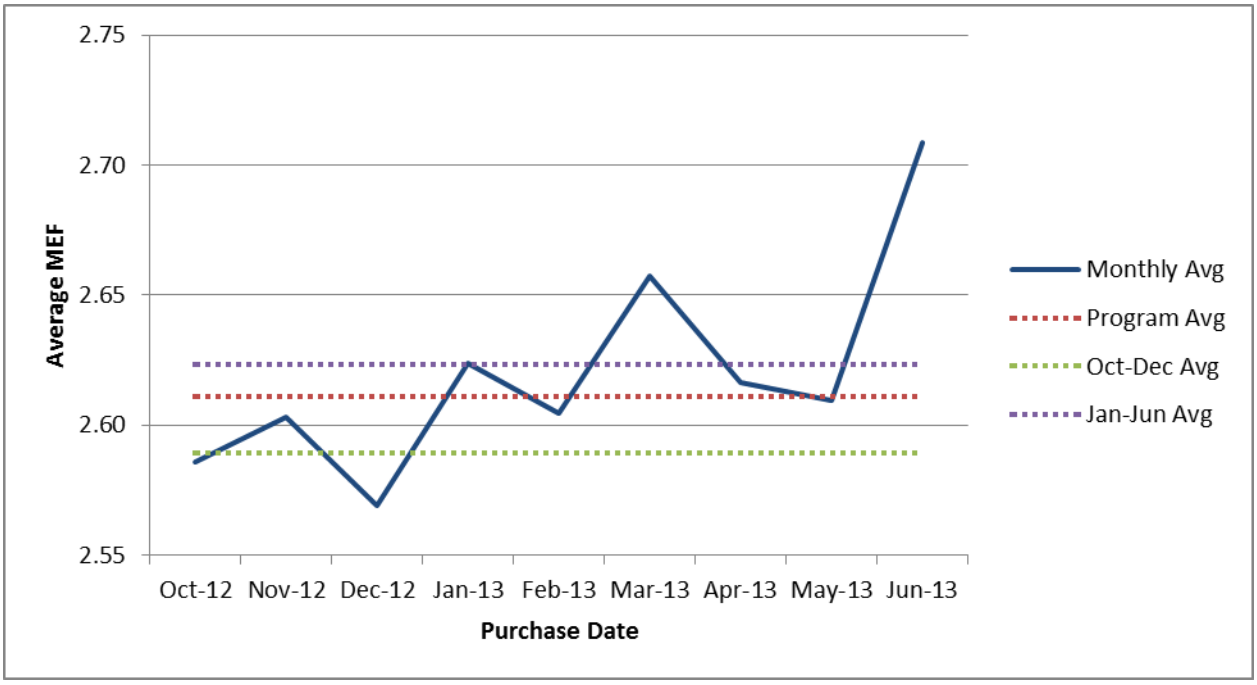
The introduction of the additional $50 rebate for the higher efficiency units had minimal effect on the proportion of higher efficiency clothes washers rebated through the program. During the first three months of clothes washer rebates (from October to December 2013) when only the $50 rebate was offered, approximately 81.0% of all rebates were for high efficiency clothes washers with an MEF value of 2.2 or higher. During the last six months of operation, from January to June 2014, the percentage increased to approximately 82.6%. As previously noted, the total number of clothes washers purchased and invoiced in June was small, resulting in a distribution different than the other months. Figure 2-6 presents the share of rebates for each MEF level.

Figure 2-6: Clothes Washer Share by MEF



In addition, the average MEF for clothes washers increased slightly after the introduction of the $100 rebate. The average MEF for all clothes washers throughout the entire program year was 2.61. The average MEF for clothes washers purchased during the first three months and the last six months were 2.59 and 2.62, respectively. Monthly averages are presented in Figure 2-7.The higher average MEF in June can be explained by the fact that of the 15 rebated clothes washers purchased and invoiced in June, 14 received $100 rebates (higher efficiency units).

Figure 2-7: Clothes Washer Average MEF



Efficiency Maine utilized the 2013 TRM deemed unit savings assumptions to assign savings values to each clothes washer. Because the $100 rebate was introduced during the middle of the program year, no alternative savings value was established for higher efficiency units, even though higher efficiency clothes washers theoretically yield higher savings. The unit kWh savings value in the 2013 TRM is sourced from the ENERGY STAR Appliance Calculator[34] accessed in 2012, [35] while assuming that 50% of homeowners use electric water heating and 100% of homeowners use electric dryers for their clothes washers.[36] The baseline is a clothes washer that is minimally compliant with the federal code defined by the Code of Federal Regulations.[37] The unit kW savings value is calculated using a load reduction factor sourced from a previous end-use metering study performed in Maine. The coincidence factor is sourced from the same study. Savings values are presented in Table 2-9.

Table 2-9: Clothes Washer *Ex-Ante* Savings Assumptions

Measure Name	Unit kW Savings	Unit Peak kW Savings	Unit kWh Savings
Clothes Washer	0.0539	0.0098	335

2.1.2.1 Standards Update

On January 1, 2011, new federal standards for all top-loading or front-loading standard-size ($1.6ft^3$ or greater) residential clothes washers took effect, increasing the minimum modified energy factor (MEF) and decreasing the maximum water factor (WF). Similarly, the ENERGY STAR criteria from the v5.0 specification took effect on January 1, 2011. On February 1, 2013, the new ENERGY STAR specification v6.0 took effect, though the MEF and WF criteria were unchanged.[38] These requirements are presented in Table 2-10.

Table 2-10: Clothes Washer Efficiency Criteria

Criteria	Federal Standard After 1/1/2011	ENERGY STAR v5.0 After 1/1/2011	ENERGY STAR v6.0 After 2/1/2013
Minimum MEF	1.26	2.0	2.0
Maximum WF	9.5	6.0	6.0

[34] United States Environmental Protection Agency (USEPA), ENERGY STAR Appliance Savings Calculator, August 2012, http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/appliance_calculator.xlsx

[35] The most recent version of the Appliance Calculator uses different assumptions, yielding lower savings when using the same inputs. One difference, which is common across the measures, is that the August 2012 version assumes MEF values higher than what is required in the ENERGY STAR specification.

[36] The 2014 TRM assumes that 24% of homeowners use electric water heating and 91% of homeowners use electric dryers, effectively reducing the per unit kWh savings for clothes washers to adjust for fuel type. Further discussion of this topic provided in Section 2.1.2.3.

[37] 10 CFR 430.32(g), http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/39

[38] ENERGY STAR Clothes Washer Specifications, accessed January 2014. https://www.energystar.gov/certified-products/detail/453/partners?fuseaction=products_for_partners.showClothesWashRes

The federal standard and ENERGY STAR v5.0 specification updates occurred prior to the FY2013 program start date, while the ENERGY STAR v6.0 specification update occurred during the middle of the program year. There were changes in the specification from v5.0 to v6.0 but none that seriously affected criteria for clothes washers eligible in the Appliance Rebate Program. Therefore, the evaluation team does not believe that the v6.0 updates had any major impact on the efficiency levels of clothes washers incented through the program.

2.1.2.2 Database Review

To confirm eligibility and key characteristics of each clothes washer, the evaluation team reviewed the program database to map all manufacturer and model number combinations to the ENERGY STAR certified products list[39] for clothes washers, herein "QPL" or "Qualified Products List". Due to the aforementioned update to the clothes washer ENERGY STAR specification, an older list of qualified clothes washers under ENERGY STAR v5.0 was also used to lookup model characteristics. The evaluation team also used the Consortium for Energy Efficiency (CEE) clothes washer QPLs[40] to determine ENERGY STAR eligibility.

The evaluation team was able to map the majority of clothes washer units to the QPLs. Modifications were needed to correct manufacturer names and model numbers for 7.3% of the records to enable proper mapping. For a very small number of entries (<0.1%), mapping was unsuccessful. A detailed breakdown of corrections made to manufacturer and/or model numbers can be found in Appendix B.2.

Based on the database review, the evaluation team identified three classes of clothes washer records.

- Clothes Washers that were mapped to the QPLs, with or without modification, were classified as *eligible ES clothes washers*.
- Of the few records that could not be mapped to the QPLs, those that were identified in the CEE QPLs were classified as *eligible CEE clothes washers*. Since the CEE specifications for Tier 1 clothes washers were identical to the ENERGY STAR specifications, the evaluation team considered these clothes washers eligible for savings.
- The remaining records that could not be mapped to the QPLs and could not be identified in the CEE QPLs (less than 0.1%) were determined to be *ineligible clothes washers*.

[39] United States Environmental Protection Agency (USEPA), ENERGY STAR Certified Clothes Washer List, January 2014. http://www.energystar.gov/productfinder/download/certified-clothes-washers/

[40] Residential Clothes Washers Qualifying Product List, January 2014. http://library.cee1.org/content/qualifying-product-lists-residential-clothes-washers

Clothes washers by classification are presented in Table 2-11.

Table 2-11: Clothes Washer by Classification

Classification	Quantity	% of Total
Eligible ES Clothes Washer	9,271	99.9%
Eligible CEE Clothes Washer	6	<0.1%
Ineligible Clothes Washer	2	<0.1%
TOTAL	**9,279**	**100%**

2.1.2.3 Energy Savings

The evaluation team calculated the *ex-post* kWh savings for clothes washers by the following:

$$\Delta kWh = kWh_{CWS\_MEF\_Baseline} - kWh_{CWS\_MEF\_Efficient}$$

Where:

$kWh_{CWS\_MEF\_Baseline}$ = Annual kWh consumption of a clothes washer system that is minimally compliant federal standards, calculated using the MEF equation

$kWh_{CW\_MEF\_Efficient}$ = Annual kWh consumption of an average clothes washer system rebated by the program, calculated using the MEF equation

The evaluation team also investigated the appropriateness of using an in-service rate to account for clothes washers that were rebated but not installed and operating. However, based on the results of the participant telephone survey, the evaluation team determined this factor would not be required. Of the 91 participants surveyed who received a rebate for a clothes washer, none responded that the new clothes washer was not operating at the time of the survey, representing a 100% in-service rate. Table 2-12 presents the breakdown by rebate amount.

Table 2-12: Clothes Washer In-Service Survey

Response	$50 Rebate Clothes Washers	$100 Rebate Clothes Washers	All Clothes Washers
Unit is operating	44	45	89
Unit is not operating	0	0	0
No Response	0	2	2
TOTAL RESPONDENTS	**44**	**47**	**91**

The energy savings algorithm for clothes washers presented in Section 2.1.2.3 appears simple, but can get very complex when breaking out each individual component. The evaluation team used an equation featuring the modified energy factor (MEF), which is a performance metric that predicts the electric consumption of an electric clothes washer system based on federal testing procedures.[41] The MEF is the quotient of the capacity of the clothes washer in cubic feet divided by the sum of the clothes washer machine energy, hot water heating energy, and energy required to remove moisture from the wash load. The rated kWh consumption of an all-electric clothes washer system using MEF is calculated by the *MEF equation*:

$$MEF\ Equation = kWh_{CWS\_MEF} = \frac{Capacity \times Loads}{MEF}$$

Where:

$Capacity$ = Volume of the clothes washer (ft^3)

$Loads$ = Number of loads (or cycles) per year

MEF = Modified Energy Factor (kWh/ft^3/cycle)

The energy consumption of an electric clothes washer system can also be expressed as the sum of its parts, namely the clothes washer, the water heater, and the clothes dryer, as shown:

$$kWh_{CWS\_MEF} = kWh_{Washer} + kWh_{Water\ Heater} + kWh_{Dryer}$$

Where:

kWh_{Washer} = Electric consumption of the clothes washer

$kWh_{Water\ Heater}$ = Electric consumption of the water heater

$kWh_{Clothes\ Dryer}$ = Electric consumption of the clothes dryer

[41] EERE, Test Procedures for Residential Clothes Washers; Final Rule, March 7, 2012. http://www.regulations.gov/#!documentDetail;D=EERE-2010-BT-TP-0021-0037

The previous algorithm calculates energy consumption as if all three components of the clothes washer system are fully electric, which is usually not the case. In order to reflect the fact that some homeowners have non-electric water heaters and/or non-electric dryers, the evaluation team multiplied $kWh_{Water\ Heater}$ by the percent of homes in Maine that have electric water heating and multiplied $kWh_{Clothes\ Dryer}$ by the percent of homes in Maine that have an electric clothes dryer. These statements can be expressed by the following equation:

$$kWh_{CWS\_MEF} = kWh_{Washer} + (kWh_{Water\ Heater} \times \%WH_{Electric}) + \left(kWh_{Dryer} \times \%Dryer_{Electric}\right)$$

Where:

$\%WH_{Electric}$ = Percent of homes in Maine with electric water heating

$\%Dryer_{Electric}$ = Percent of homes in Maine with electric clothes dryer

The algorithm requires knowing the energy consumption of each individual component in order to apply $\%WH_{Electric}$ and $\%Dryer_{Electric}$ correctly. To allocate electric consumption to each component, the ENERGY STAR calculator uses an unusual strategy that automatically allocates any delta energy consumption to the electric dryer if the capacity, loads, or MEF assumptions change from the defaults. To remedy this effect, the evaluation team deployed meters, as described in Section 1.3.1.5, to capture the average electric consumption data for the three components of rebated clothes washer systems per cycle and developed savings allocation percentages. Therefore, the electric consumption of each component can be expressed as a function of the total electric consumption of the clothes washer system:

$$kWh_{Washer} = kWh_{CWS\_MEF} \times CWS_{\%Washer}$$

$$kWh_{Water\ Heater} = kWh_{CWS\_MEF} \times CWS_{\%Water\ Heater}$$

$$kWh_{Dryer} = kWh_{CWS\_MEF} \times CWS_{\%Dryer}$$

Where:

$CWS_{\%Washer}$ = Percent of system kWh allocated to clothes washer

$CWS_{\%Water\ Heater}$ = Percent of system kWh allocated to water heater

$CWS_{\%Dryer}$ = Percent of system kWh allocated to clothes dryer

The following paragraphs detail the results of the data collection.

Using data from the QPLs, the evaluation team calculated program averages for capacity and MEF values. The evaluation team also calculated the per cycle energy consumption using the program averages. The QPLs also provide the rated annual kWh consumption of the clothes washer machine (which estimates energy consumption for the washer and water heating).[42] Parameter averages are presented in Table 2-13.

Table 2-13: Clothes Washer Parameter Averages

Rebate Amount	# of Clothes Washers	Capacity (ft^3)	MEF	kWh Per Cycle	Machine kWh
$50 Rebate	4,950	3.74	2.49	1.50	151.1
$100 Rebate	4,321	3.90	2.75	1.42	137.0
ALL CLOTHES WASHERS	**9,271**	**3.81**	**2.61**	**1.46**	**144.5**

The evaluation team calculated the average number of washer and dryer cycles using two data collection approaches. The first approach was to ask all customers to estimate the number of washer and dryer cycles per week. The second approach was to identify the number of loads through the metering data. For the purposes of calculating the number of loads, the evaluation team took results from both rebated and non-program clothes washers and clothes dryers. The number of loads for each system is normalized to represent number of cycles per week, such that comparisons can be made. Because metered results have greater reliability than self-report values, the evaluation team assigned a $2/3^{rd}$ weight to the metered-derived value and a $1/3^{rd}$ weight to the survey-derived value in order to determine a final average. Weighted averages are presented in Table 2-14.

Table 2-14: Clothes Washer and Dryer Loads per Week

Appliance	Source	Average Loads per Week	Average Loads per Year	Sample Size, n
Clothes Washer	Recruiting Survey	6.36	330.9	22
	Metering Study	6.12	318.1	45
	Average	**6.20**	**322.4**	**N/A**
Clothes Dryer	Recruiting Survey	6.00	312.0	22
	Metering Study	5.94	308.9	20
	Average	**5.96**	**310.0**	**N/A**

[42] This value is used for the ENERGY STAR appliance calculator's methodology for estimating savings, but is not used by the evaluation team.

The calculated number of 322.4 clothes washer loads per year is slightly higher than the 312 figure used in the ENERGY STAR appliance calculator (which provides no ability to make regional adjustments). An analysis of 2009 Residential Energy Consumption Survey (RECS) data[43] yields an average of 301 loads per year, though this estimate includes other states in the Northeast in addition to Maine. The higher number for Maine may simply reflect higher usage by program participants than by residents of other states. In general, the use of 322.4 loads per year yields approximately 3% higher savings than the default ENERGY STAR appliance calculator savings, which the evaluation team finds reasonable.[44]

Based on the telephone survey for clothes washer participants, the evaluation team determined that 23% of homes have electric water heating ($\%WH_{Electric}$). This value is within the range of available data – previous Efficiency Maine program data from RHA and PACE from 2011 through June 2013[45] estimate that 24% of homeowners use electric water heating while 2009 RECS data[46] estimate that 30% of homeowners in northeastern states[47] use electric water heating. Complete responses from the survey are presented in Table 2-15.

Table 2-15: Water Heater Fuel Type

Water Heater Fuel Type	N	Percent of Total
Fuel Oil, Heating Oil, or #2 Oil	41	53%
Electric	18	23%
Natural Gas from Underground Pipes	8	10%
Bottle or Tank Gas	7	9%
Other	4	5%
TOTAL	**80**	**100%**

[43] http://www.eia.gov/consumption/residential/

[44] The data also implies that approximately 96% of clothes washer loads are dried in clothes dryers. This value agrees with the DOE rulings.

[45] Efficiency Maine 2014 TRM

[46] Table HC8.8, "Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009." http://www.eia.gov/consumption/residential/data/2009/

[47] RECS 2009 lumps Maine together with Connecticut, New Hampshire, Rhode Island, and Vermont. This estimate assumes that the distribution is the same across all states.

The evaluation team collected results from the recruiting survey for the on-site visits and determined that 89.6% of homes have electric dryers ($\%Dryer_{Electric}$). This value is also within the range of available data – 2009 RECS data indicates that 91% of homeowners in the northeastern states have electric clothes dryers.[48] Complete responses from the recruiting calls are presented in Table 2-16.

Table 2-16: Clothes Dryer Fuel Type

Clothes Dryer Fuel Type	N	Percent of Total
Electric	69	89.6%
Gas	6	7.8%
Propane	2	2.6%
Other	0	0%
TOTAL	**77[1]**	**100%**

[1] The evaluation team asked potential participants about the clothes dryer fuel type (and information pertaining to other measures) during recruiting calls prior to confirming on-site visits. Any homes with rebated clothes washer systems and non-electric clothes dryers were disqualified from the metering study, as well as other homes that did not meet certain criteria.

The evaluation team determined the allocation of energy consumption between the clothes washer, water heater and clothes dryer using cycle-normalized data collected through on-site metering. The allocation factors are presented in Table 2-17.

Table 2-17: Clothes Washer System Allocation Factors

System Component	Variable	Allocation Factor
Clothes Washer	$CWS_{\%Washer}$	3.5%
Water Heater	$CWS_{\%Water\ Heater}$	24.3%
Clothes Dryer	$CWS_{\%Dryer}$	72.2%

Using these parameters, the evaluation team calculated the *ex-post* kWh savings as follows:

$$\Delta kWh = kWh_{CWS\_MEF\_Baseline} - kWh_{CWS\_MEF\_Efficient}$$

$$\Delta kWh = 719.72 - 347.29 = 372.43\ kWh$$

The resultant *ex-post* unit annual kWh savings is higher than the *ex-ante* savings of 335 kWh and substantially higher than the 2014 TRM value of 162.5 kWh. This can be attributed to several major factors. First, the average capacity of a program clothes washer was 3.81 ft^3, which is 0.71 ft^3 higher than the assumed value in the ENERGY STAR calculator. Second, the average MEF of a program clothes washer during FY2013 was 2.61 compared to 2.00, which was the assumed MEF used to calculate the unit *ex-ante* savings for clothes washers in the 2013 TRM. Both the

[48] Ibid.

ex-ante and *ex-post* calculations used the 1.26 MEF value for the baseline unit. Lastly, the number of loads estimated in the evaluation was slightly higher than the default value, leading to another bump in savings.

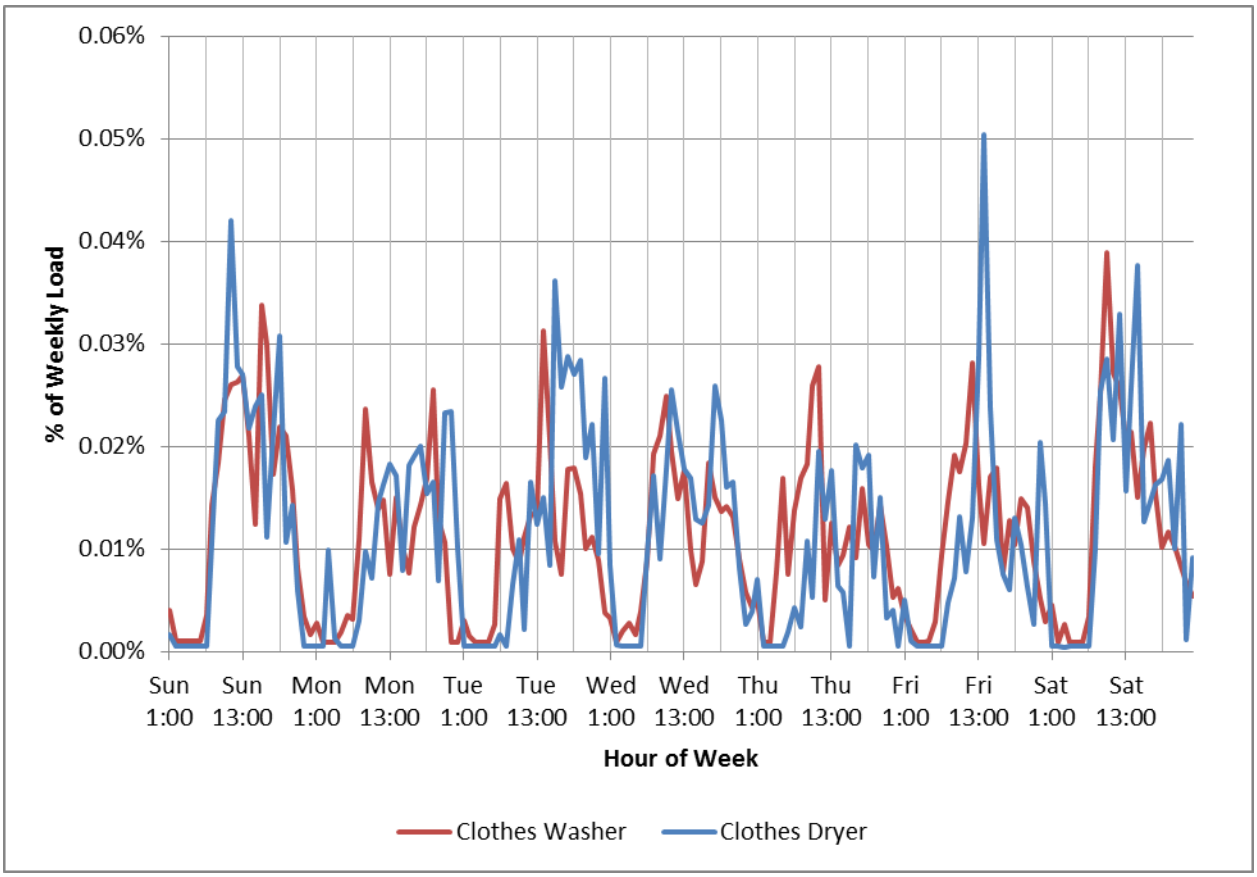
The *ex-post* unit annual kWh savings value found here is also higher than values reported by other evaluation studies. However, due to the quickly evolving nature of the ENERGY STAR specifications, it is difficult to compare results from this study to any studies performed before 2011, when new federal standards and ENERGY STAR specifications took effect. Regardless, one study estimates savings in the range of 288 kWh per year for a clothes washer system with an MEF of 2.0.[49] Given the average MEF rating of 2.61 for the Efficiency Maine program, a higher savings estimate seems reasonable.

[49] Residential Retrofit High Impact Measure Evaluation Report, page 49. February 2010. http://www.calmac.org/publications/FinalResidentialRetroEvaluationReport_11.pdf

2.1.2.4 Demand Savings

The combined load profiles for clothes washers and clothes dryers are presented in Figure 2-8. The data shows that the clothes dryer generally lags behind the clothes washer, which validates the intuitive notion that clothes dryers are used after clothes washers. This profile exhibits many peaks and valleys, demonstrating the behavior of customers mostly doing laundry during weekday evenings and weekend afternoons but less so during the early morning hours.

Figure 2-8: Clothes Washer and Clothes Dryer Weekly Load Profile



The evaluation team calculated summer peak demand savings by first applying the generated load profile to the annual energy savings to determine average hourly demand savings and then isolating the ISO-NE summer on-peak hours. Because a load shape was generated for clothes washers and clothes dryers, the evaluation team proportioned the kWh savings according to the allocation factors. The *ex-post* unit peak demand savings is calculated to be 0.0550 kW.

The resultant *ex-post* demand savings is approximately 563% of the *ex-ante* savings and 399% of the 2014 TRM estimates. Some of the difference can be attributed to higher energy savings, which is the basis for demand savings. In addition, it is unclear if the *ex-ante* load reduction factor and coincidence factor derived from older studies align properly with the current peak demand window, which is especially important for clothes washers where the load profile shows time-dependent behavior.

2.1.2.5 Decision Type Analysis

The evaluation team was able to interview 20 on-site participants who received a rebate for a new clothes washer and were able to estimate the age of their previous clothes washer. Because most old clothes washers were removed from the property, the evaluation team relied on self-reports from the participant. Average ages are presented in Table 2-18.

Table 2-18: Previous Clothes Washer Average Life

Previous Clothes Washer Age[1]	Average Age (years)	Respondents (n)
6 Years Old or Less	5.5	2
Less than 11 Years Old but More than 6 Years Old	9.3	12
More than 11 Years Old	18.0	6
Could not Recall	N/A	2
ALL PREVIOUS CLOTHES WASHERS[2]	**11.5**	**20**

[1] Eleven years is used as the cut-off because the effective useful life for clothes washers is 11 years.
[2] Does not include the 2 non-responses in the total.

Given that clothes washers have an 11 year effective useful life (according to the 2013 TRM), clothes washers that are over 11 years old have exceeded their useful life. Rebated clothes washers replacing these old clothes washers represent a new or replacement scenario. The evaluation team categorized clothes washers that were 11 years old or less as having remaining useful life; rebated clothes washers replacing these units could represent an "early replacement" scenario.

Based on these 20 interview responses, approximately 70% of clothes washers could be considered early replacement. Based on a more conservative estimate that considers only situations where the replaced unit still has more than half its effective useful life remaining, this figure drops to 10%.

2.1.2.6 Savings Summary

Through metering and analysis activities, the evaluation team calculated unit *ex-post* savings values, presented in Table 2-19.

Table 2-19: Clothes Washer *Ex-Post* Savings Assumptions

Measure Name	Unit Peak kW Savings	Unit kWh Savings
Clothes Washer	0.0550	372.43

To calculate the total gross *ex-post* for clothes washers, the evaluation team applied the unit *ex-post* savings to only eligible clothes washers. Realization rates are expressed as the gross *ex-post* savings divided by the gross *ex-ante* savings. A summary of results for clothes washers is presented in Table 2-20.

Table 2-20: Clothes Washer Savings Summary

Savings Type	Peak kW Savings	kWh Savings
# of Units Rebated	9,279	9,279
Gross *Ex-Ante* Savings	90.5	3,108,465
# of Units Eligible	9,277	9,277
Gross *Ex-Post* Savings	509.9	3,454,995
Realization Rate	563.3%	111.1%
Relative Precision at 90% Confidence	11.7%	11.7%
Relative Precision at 80% Confidence	9.1%	9.1%
Coefficient of Variance (Cv)	1.39	1.39

2.1.3 Dehumidifiers

The evaluation team reviewed the program database and identified 906 dehumidifiers incented by the program in FY2013. Homeowners received a $25 rebate for an ENERGY STAR dehumidifier. The majority of dehumidifier sales occurred near the summer months, reflecting the fact that most homeowners are concerned about indoor humidity during the summer months when absolute humidity is at its peak.

Efficiency Maine utilized 2013 TRM assumptions to assign *ex-ante* savings values to dehumidifiers. The unit kWh savings value is sourced from the ENERGY STAR Appliance Calculator[50] accessed in 2012[51], using the 50 pint/day unit as a proxy for all units. The unit kW savings value is calculated using a load reduction factor sourced from a previous end-use metering study performed in Maine. The coincidence factor is sourced from the 2008 Vermont TRM. Savings values are presented in Table 2-21.

Table 2-21: Dehumidifier *Ex-Ante* Savings Assumptions

Measure Name	Unit kW Savings	Unit Peak kW Savings	Unit kWh Savings
Dehumidifier	0.072	0.0597	268

[50] United States Environmental Protection Agency (USEPA), ENERGY STAR Appliance Savings Calculator, August 2012, http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/appliance_calculator.xlsx

[51] As of the most recent version accessed in January 2014, the ENERGY STAR Appliance Calculator now calculates savings based on the updated ENERGY STAR specifications, yielding different savings values. As was common with the August 2012 version, the Appliance Calculator calculated savings using the assumption that units would exceed the ENERGY STAR minimum criteria, yielding higher savings compared to units that simply meet the criteria.

2.1.3.1 Standards Update

On October 1, 2012, new federal standards for dehumidifiers took effect, increasing the minimum energy factors (i.e., liters per kWh) for all units. The ENERGY STAR specification v3.0 for dehumidifiers was also adopted on October 1, 2012. The minimum energy factors for each standard are presented in Table 2-22.

Table 2-22: Dehumidifier Minimum Energy Factors (liters/kWh)

Product capacity (pints/day)	Federal Standard Before 10/1/2012	Federal Standard After 10/1/2012	ENERGY STAR v2.1 Before 10/1/2012	ENERGY STAR v3.0 After 10/1/2012
25.00 or less	1.00	1.35	1.20	1.85
25.01-35.00	1.20	1.35	1.40	1.85
35.01-45.00	1.30	1.50	1.50	1.85
45.01-54.00	1.30	1.60	1.60	1.85
54.01-75.00[1]	1.50	1.70	1.60	1.85
75.01-185.00[1,2]	2.25	2.50	2.50	2.80

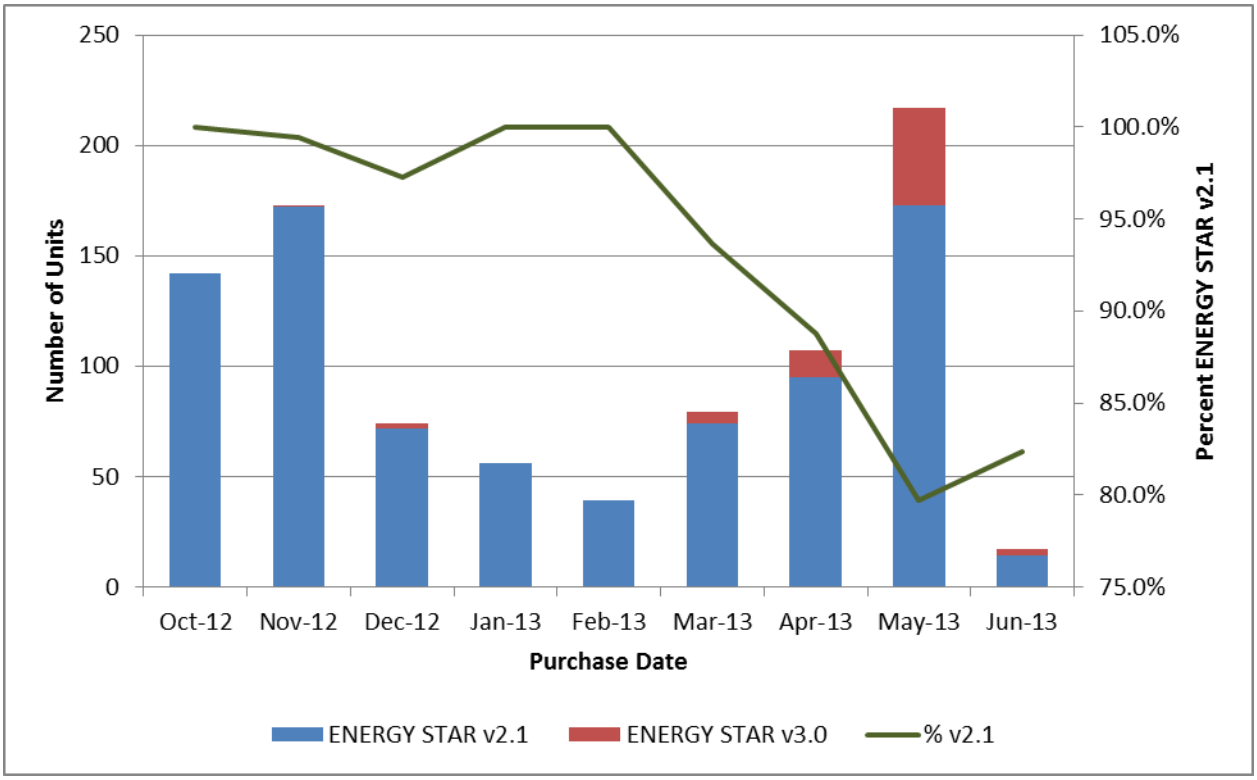
[1] The federal standard for dehumidifiers before 10/1/2012 listed the bins as 54.01-74.99 and 75.00 and above. After 10/1/2012, the bins were modified to 54.01-75.00 and 75.00 and above. For the sake of simplicity in presentation, the capacity bins are modified slightly.

[2] The federal standards apply the minimum energy factor criteria to all dehumidifiers above 75 pints/day, whereas the ENERGY STAR criteria only apply to dehumidifiers from 75.01 pints/day to 185.00 pints/day.

These October 2012 federal updates coincided with the start of the Appliance Rebate Program for FY2013. Because retailer stocks can take months to transform, many dehumidifiers certified through the old ENERGY STAR specification v2.1 were rebated through the program. These simultaneous changes complicate eligibility screening for dehumidifiers as some units may have qualified under ENERGY STAR v2.1 but not under ENERGY STAR v3.0. In some cases, such as for units with a capacity smaller than 25 pints/day, dehumidifiers that qualified as ENERGY STAR in September 2012 may not even meet the federal minimum requirements in November 2012.

Throughout the duration of the program, the majority of dehumidifiers rebated were certified under ENERGY STAR v2.1. The lowest share of rebates for ENERGY STAR v2.1 dehumidifiers occurred in the month of May, when ENERGY STAR v2.1 certified dehumidifiers accounted for approximately 80% of all dehumidifier rebates. It appears that the share of ENERGY STAR v3.0 dehumidifiers was on an upward trend from March 2013 to May 2013, suggesting that these dehumidifiers were starting to penetrate the market. However, it is clear that there was still a healthy stock of ENERGY STAR v2.1 dehumidifiers available in retail stores. The monthly numbers of dehumidifiers rebated by the program are presented in Figure 2-9.

Figure 2-9: Dehumidifier Counts by Specification



The evaluation team determined that any dehumidifier certified as ENERGY STAR would be counted eligible for the program. In general, dehumidifiers certified under ENERGY STAR v2.1 were compared against the federal standard in effect prior to October 1, 2012 and dehumidifiers certified under ENERGY STAR v3.0 were compared against the federal standard in effect after October 1, 2012.

2.1.3.2 Database Review

To confirm eligibility and key characteristics of each dehumidifier, the evaluation team reviewed the program database to map all manufacturer and model number combinations to the ENERGY STAR certified products list[52] for dehumidifiers, herein "QPL" or "Qualified Products List". Due to the aforementioned update to the dehumidifier ENERGY STAR specification, an older list of qualified dehumidifiers under ENERGY STAR v2.1 was also used to lookup model characteristics.

The evaluation team was able to map all but two dehumidifiers to the established QPLs, though 42.9% of records required some modification to the manufacturer or model number to map properly to the QPLs. For the remaining dehumidifiers, the evaluation team determined that one was certified and the other was not. A detailed breakdown of manufacturer and model number corrections is listed in Appendix B.3.

Based on the database review, the evaluation team classified dehumidifiers into four categories.

- Dehumidifiers that were mapped to the ENERGY STAR v3.0 QPL, with or without correction, were classified as *ES v3.0 dehumidifiers*. Savings are calculated against the federal standard effective after October 1, 2012.
- Dehumidifiers that were mapped to the ENERGY STAR v2.1 QPL, with or without correction, were classified as *ES v2.1 dehumidifiers*. Savings are calculated against the federal standard effective before October 1, 2012.
- Dehumidifiers that were determined to be ENERGY STAR but were not found on either QPL list were classified as *unknown ES dehumidifiers*. Since the ENERGY STAR v3.0 QPL is current, it is assumed that dehumidifiers under this category are from v2.1 and savings are determined as such.
- Dehumidifiers that were never certified are classified as *ineligible dehumidifiers* and were not credited with any savings.

Dehumidifiers by classification are presented in Table 2-23.

Table 2-23: Dehumidifiers by Classification

Classification	Quantity	% of Total
ES v3.0 Dehumidifier	67	7.4%
ES v2.1 Dehumidifier	837	92.4%
Unknown ES Dehumidifier	1	0.1%
Ineligible Dehumidifier	1	0.1%
TOTAL	**906**	**100%**

[52] United States Environmental Protection Agency (USEPA), ENERGY STAR Certified Dehumidifier List, January 2014. http://www.energystar.gov/productfinder/download/certified-dehumidifiers/.

2.1.3.3 Energy Savings

The evaluation team calculated the *ex-post* kWh savings for dehumidifiers by the following:

$$\Delta kWh = Capacity \times 0.473 \times \frac{Hours}{24} \times \left(\frac{1}{EF_{Baseline}} - \frac{1}{EF_{Efficient}}\right) \times ISA$$

Where:

$Capacity$	= Rated capacity of dehumidifier in pints/day
0.473	= Conversion factor from pints/day to liters/day
$Hours$	= Annual operating hours
24	= Conversion factor from hours to days
$EF_{Baseline}$	= Minimum required Energy Factor of dehumidifier based on federal code
$EF_{Efficient}$	= Rated Energy Factor of efficient dehumidifier
ISA	= *In-situ* adjustment factor to account for "real world" conditions

One major difference between the *ex-ante* and *ex-post* savings is that the evaluation team used the actual EF and capacity to calculate savings. The evaluation team also calculated savings separately for the two specifications due to differences in the baseline code efficiency levels. Lastly, metered data was used to derive an *in situ* adjustment.

The evaluation team contemplated using an in-service rate factor to account for dehumidifiers that were rebated but not installed and operating. Based on the results of the participant survey, the evaluation team determined an adjustment was not needed. Of the 49 participants surveyed who received a rebate for a dehumidifier, only three responded that the new dehumidifier was not operating at the time of the survey. All three respondents indicated that the dehumidifier would be installed within the month. A breakdown of responses is presented in Table 2-24.

Table 2-24: Dehumidifier In-Service Survey

Response	All Dehumidifiers
Unit is operating	46
Unit is not operating	3
…If not, unit will be operating in 1 month	3
No Response	0
TOTAL RESPONDENTS	**49**

Using data provided in the QPLs, the evaluation team identified the capacity, EF_{Rated} and $EF_{Federal\ Standard}$ for each dehumidifier rebated through the program. Averages for each of these variables are presented in Table 2-25.

Table 2-25: Dehumidifier Average Capacity and Energy Factors in FY2013

Classification	Quantity	Average Capacity (pints/day)	Average EF (kWh/liter)	Average Code EF (kWh/liter)
ES v3.0 Dehumidifier	67	63.4	1.85	1.65
ES v2.1 Dehumidifier	837	50.9	1.61	1.34

The energy savings algorithm can be rearranged to yield an equation that compares energy consumption of a minimally code-compliant dehumidifier and an ENERGY STAR dehumidifier as follows:

$$\Delta kWh = \left(\frac{Capacity \times 0.473 \times Hours}{EF_{Federal\ Standard} \times 24} - \frac{Capacity \times 0.473 \times Hours}{EF_{Rated} \times 24}\right) \times ISA$$

$$\Delta kWh = (kWh_{Federal\ Standard} - kWh_{Rated}) \times ISA$$

This relationship relies on the fact that the energy consumption of a single dehumidifier can be expressed as a function of capacity, energy factor and operating hours:

$$kWh_{Dehumidifier} = \frac{Capacity \times 0.473 \times Hours}{EF \times 24}$$

From the metering data, the evaluation team observed that dehumidifiers have two operating modes: standby and full operation. Most dehumidifiers drew one watt compared to 400-700 watts during full operation, i.e., power draw during standby mode was negligible. Therefore, dividing the annual energy consumption by hours gives a reasonable estimate of the operational power draw of a dehumidifier unit. This can be expressed as follows:

$$kW_{Dehumidifier} = \frac{Capacity \times 0.473}{EF \times 24}$$

The evaluation team derived the *ISA* factor by comparing the metered power draw (calculated as the straight average of all readings above 150W[53]) against the rated power draw (calculated using the equation above) for each metered dehumidifier. The *ISA* factor is calculated as a straight average because the evaluation team believes that the *ISA* factor is independent of capacity and energy factor. The calculation for the *ISA* factor is as follows:

$$ISA = \frac{1}{n}\sum_{i=1}^{n}\frac{kW_{Actual}}{kW_{Rated}}$$

The statistical results for the *ISA* factor are provided in Table 2-26.

Table 2-26: Dehumidifier *ISA* Estimates

Statistics	ISA
Mean Value (μ)	81.6%
Samples (n)	13
Relative Precision at 90% Confidence	3.4%
Relative Precision at 80% Confidence	2.7%
Coefficient of Variance (Cv)	0.08

As defined by the algorithm, the operating hours represents the amount of time that the dehumidifier is actively removing moisture from the air and excludes time that the dehumidifier is idle. As expected, energy consumption of a dehumidifier is highly dependent on the operating hours of the unit, which can vary dramatically from homeowner to homeowner. Using metered data, the evaluation team attempted to create a regression model to develop a weather-normalized load shape. Without accounting for weather effects, annual operating hours range from 0 hours to 7,500 hours and the average was approximately 3,500 hours. Dehumidifiers metered during the first round of site visits, which were closest to the summer months, typically showed close to constant operation except for times when condensate buckets were not emptied promptly. Units metered during later rounds of site visits, which extended from the fall into the winter months, exhibited more diverse operating hours, including one unit that did not operate at all. Due to limited sample sizes and exposure to seasonal changes, the evaluation team instead opted to assume annual operating hours of 1,632, in line with the 2014 TRM.

Several factors made estimation of operating hours difficult. For units with condensate buckets, continuous operation relies on the homeowner to empty the bucket frequently; otherwise, the dehumidifier will stop operating. Several homeowners indicated that they did not empty the bucket promptly, which was corroborated by metered data. This caused major issues for the

[53] While the majority of idle time was recorded at a very small wattage, during periods of high usage, the idle wattage sometimes jumped to approximately 50 watts for a very short period of time, depending on the unit. For one unit, this jumped to approximately 100 watts. The cutoff was set to 150W to properly assess maximum power draw during times of operation.

regression model, because according to temperature conditions, the unit should be running – in actuality it was not because of the full bucket. Control set-points can also lead to varying results, as many dehumidifiers have humidistats to set the desired relative humidity levels. For example, a unit with a set-point of 40% RH would operate longer than an identical unit with a set-point of 55% RH. Finally, while the majority of dehumidifiers are placed in the basement, the construction of the home, amount of infiltration, and space conditioning all affect the operating cycles. The evaluation team surveyed homeowners regarding some of these issues. While this information is useful qualitatively, sample sizes were not large enough to counteract the variability of the metered data. Results are presented in Table 2-27.

Table 2-27: Dehumidifier Survey Responses

Parameter	Mean Value (μ)	Samples (n)
Use Relative Humidity Setting	46%	19
Drain Connected	41%	34
…Bucket Emptied Promptly	74%	19
Days of Operation	176	34

The evaluation team calculated savings for ENERGY STAR specification v3.0 and v2.1 independently. The results for each specification are as follows:

$$\Delta kWh_{v3.0} = 63.4 \times 0.473 \times \frac{1632}{24} \times \left(\frac{1}{1.65} - \frac{1}{1.85}\right) \times 81.6\% = 109.02\ kWh$$

$$\Delta kWh_{v2.1} = 50.9 \times 0.473 \times \frac{1632}{24} \times \left(\frac{1}{1.34} - \frac{1}{1.61}\right) \times 81.6\% = 167.19\ kWh$$

The *ex-post* unit kWh savings were calculated using a weighted average based on the number of dehumidifiers rebated through the program. The result is as follows:

$$\Delta kWh = 162.88\ kWh$$

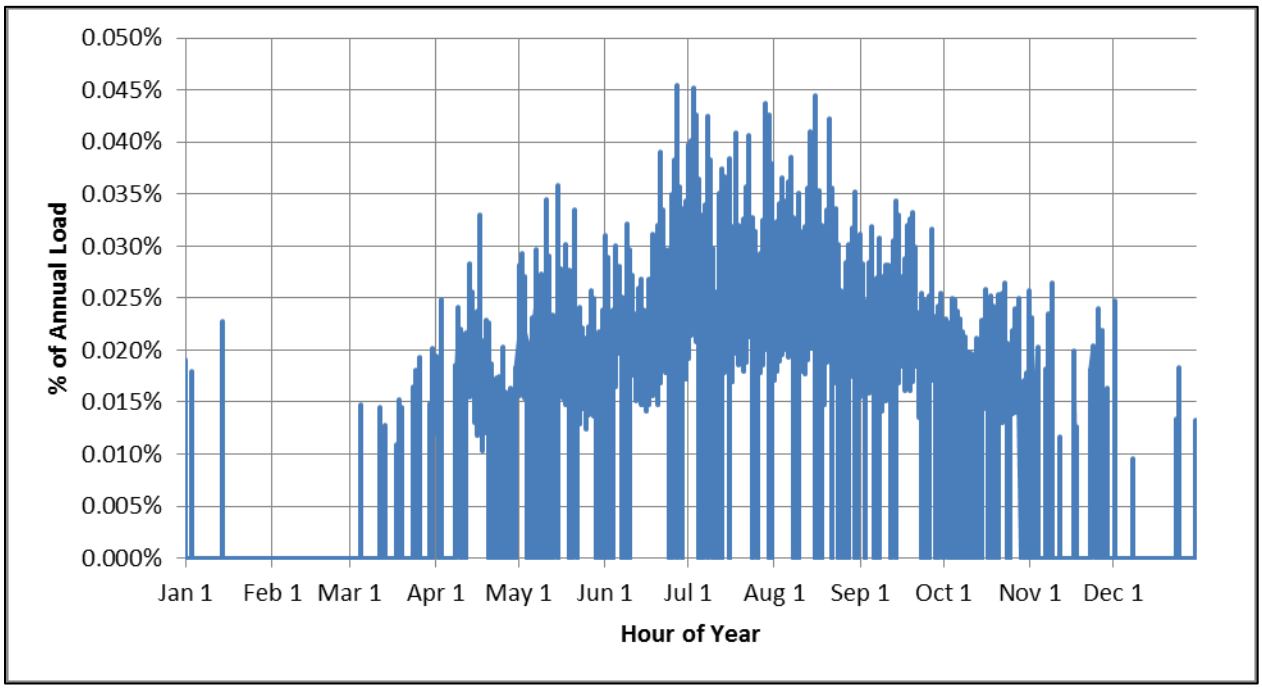
Although the *ex-post* unit savings are approximately 40% lower than the *ex-ante* savings, the evaluation team notes that the *ex-post* unit savings value is very close to the unit savings value in the 2014 TRM. It should be noted that as newer, more efficient dehumidifiers become available, the savings estimate will decrease due to comparisons against the new federal standard.

Comparisons to existing evaluation reports are difficult for dehumidifiers because federal and ENERGY STAR standards were recently updated. This evaluation report would be among the first to present savings for the new ENERGY STAR v3.0 dehumidifiers.

2.1.3.4 Demand Savings

The evaluation team developed a weather normalized 8760 load shape based on metered dehumidifiers and is presented in Figure 2-10. Due to the variability of metered data, there is a level of uncertainty with the estimated load shape.

Figure 2-10: Dehumidifier Annual Load Profile



The evaluation team calculated peak demand savings by first applying the generated load profile to the annual energy savings to determine average hourly demand savings and then isolating the ISO-NE peak hours. The resultant unit peak demand savings is 0.0373 kW.

2.1.3.5 Decision Type Analysis

The evaluation team was able to interview 12 participants who received a rebate for a dehumidifier and were able to estimate the age of their previous dehumidifier. Because most of these dehumidifiers were removed from the property after the installation of the new rebated dehumidifier, the evaluation team relied on self-reports from the participant. Average ages are presented in Table 2-28.

Table 2-28: Previous Dehumidifier Average Life

Previous Dehumidifier Age[1]	Average Age (years)	Respondents (n)
6 Years Old or Less	1.3	2
Less than 12 Years Old but More than 6 Years Old	9.3	3
More than 12 Years Old	26.0	2
No Previous Unit	N/A	5
Could not Recall	N/A	1
ALL PREVIOUS DEHUMIDIFIERS[2]	**11.8**	**12**

[1] Twelve years is used as the cut-off because the effective useful life for dehumidifier is 12 years.
[2] Does not include the 1 non-response in the total.

Given that dehumidifiers have a 12 year effective useful life (according to the TRM), the evaluation team defined old dehumidifiers that are over 12 years old as exceeding their useful life. Therefore, rebated dehumidifiers replacing dehumidifiers exceeding useful life represent a new or replacement scenario. The evaluation team identified dehumidifiers that are 12 years old or less as dehumidifiers with remaining useful life; these could be considered as early replacement scenarios.

Based on these 12 interview responses, approximately 42% of dehumidifiers could be considered early replacement. With a more conservative estimate that defines early replacement as a situation where the replaced unit still has more than half its effective useful life remaining, this figure drops to 17%.

2.1.3.6 Savings Summary

Through metering and analysis activities, the evaluation team calculated unit *ex-post* savings values, presented in Table 2-29.

Table 2-29: Dehumidifier *Ex-Post* Savings Assumptions

Measure Name	Unit Peak kW Savings	Unit kWh Savings
Dehumidifier	0.037	162.88

To calculate the total gross *ex-post* for dehumidifiers, the evaluation team applied the unit *ex-post* savings to only eligible dehumidifiers. Realization rates are expressed as the gross *ex-post* savings divided by the gross *ex-ante* savings. A summary of results for dehumidifiers is presented in Table 2-30.

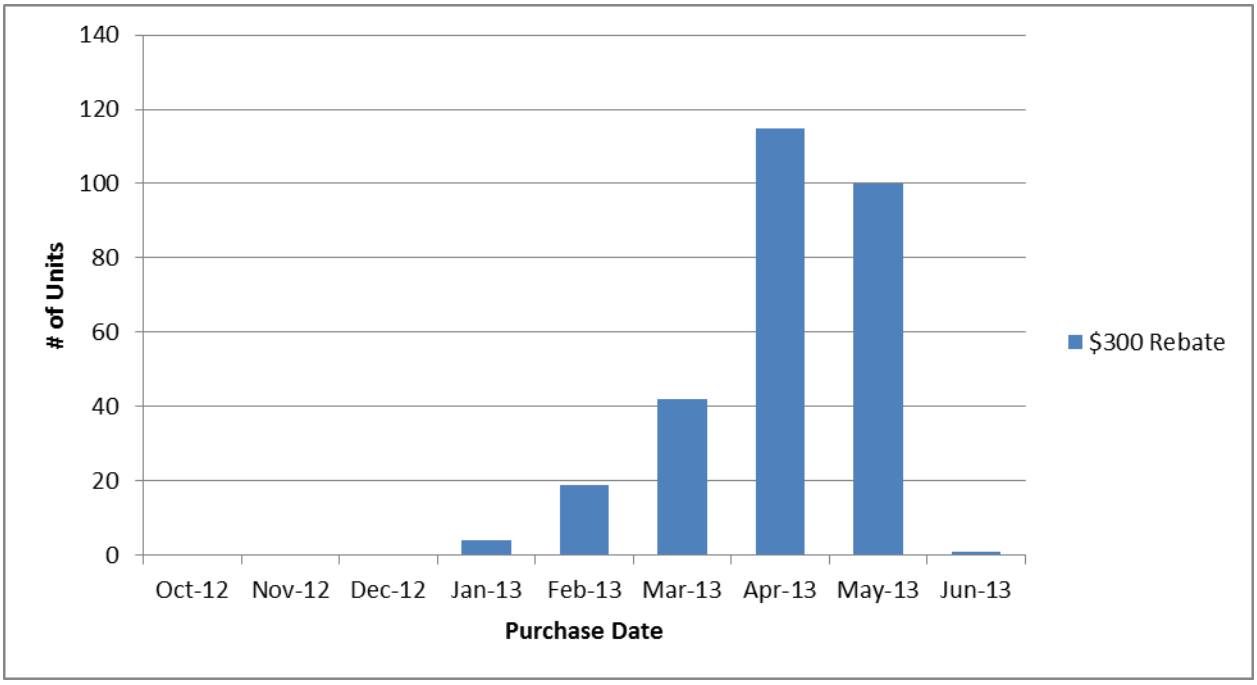
Table 2-30: Dehumidifier Savings Summary

Savings Type	Peak kW Savings	kWh Savings
# of Units Rebated	906	906
Gross *Ex-Ante* Savings	54.1	242,808
# of Units Eligible	905	905
Gross *Ex-Post* Savings	33.8	147,410
Realization Rate	62.4%	60.7%
Relative Precision at 90% Confidence	3.4%	3.4%
Relative Precision at 80% Confidence	2.7%	2.7%
Coefficient of Variance (Cv)	0.08	0.08

2.1.4 Heat Pump Water Heaters

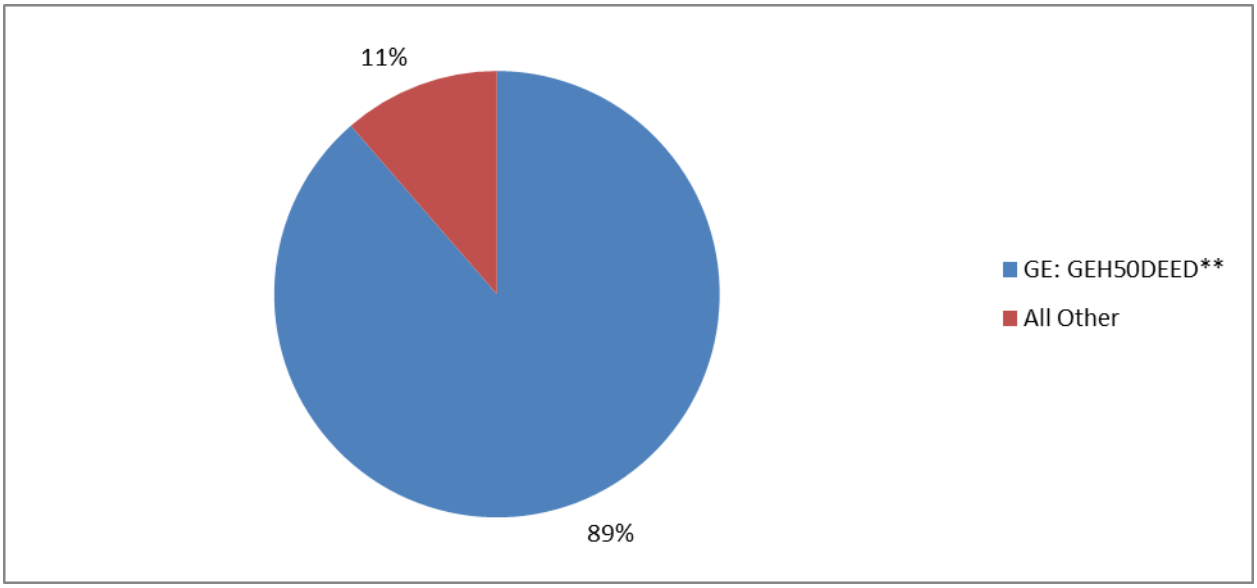
The evaluation team reviewed the program database and identified 281 heat pump water heaters incented by the program in FY2013. Homeowners received a rebate of $300 for purchasing an ENERGY STAR heat pump water heater. Participation by month is presented in Figure 2-11.

Figure 2-11: Heat Pump Water Heater Counts



This measure was dominated by one specific manufacturer (GE) and model combination, accounting for 89% of all units rebated by the program.

Table 2-31: Heat Pump Water Heater Distribution by Manufacturer and Model Number



Efficiency Maine utilized various assumptions to assign *ex-ante* savings values to heat pump water heaters. The unit kWh savings value is sourced from the Efficiency Maine Trust Baseline Opportunities Study[54] conducted in 2012. The unit kW savings value is calculated using a load reduction factor sourced from the 2008 Vermont TRM. The coincidence factor is sourced from a manufacturer study. Savings values are presented in Table 2-32.

Table 2-32: Heat Pump Water Heater *Ex-Ante* Savings Assumptions

Measure Name	Unit kW Savings	Unit Peak kW Savings	Unit kWh Savings
Heat Pump Water Heater	0.917	0.088	2,214

2.1.4.1 Database Review

To confirm eligibility and key characteristics of each heat pump water heater, the evaluation team reviewed the program database to map all manufacturer and model number combinations to the ENERGY STAR certified products list[55] for heat pump water heaters, herein "QPL" or "Qualified Products List".

The evaluation team was able to map the majority of units to the QPL, with only 6.4% requiring some modification to the manufacturer or model number to enable proper mapping. For the

[54] EMT Baseline Opportunities Study, September 2012. http://www.efficiencymaine.com/docs/Cadmus-Baseline-Opps.pdf

[55] United States Environmental Protection Agency (USEPA), ENERGY STAR Certified Water Heater List, January 2014. http://www.energystar.gov/productfinder/download/certified-water-heaters/

remaining units, the evaluation team determined that all were ENERGY STAR certified, based on a review of unit specifications and cut sheets. A detailed breakdown of manufacturer and model number corrections is listed in Appendix B.3.

Since all units were considered ENERGY STAR certified, all heat pump water heaters were classified together. No heat pump water heater units in the program were declared ineligible.

Total numbers are listed in Table 2-33.

Table 2-33: Heat Pump Water Heaters by Classification

Classification	Quantity	% of Total
Eligible ES Heat Pump Water Heater	281	100.0%
Ineligible ES Heat Pump Water Heater	0	0.0%
TOTAL	**281**	**100%**

2.1.4.2 Energy Savings

The evaluation team calculated the *ex-post* kWh savings for heat pump water heaters by the following equation:

$$\Delta kWh = \frac{GPD \times 365 \times \rho_{H20} \times Cp_{H20} \times (T_{WH} - T_{in})}{3413} \times \left(\frac{1}{EF_{Federal\ Standard}} - \frac{1}{EF_{Rated}}\right)$$

Where:

GPD = Average daily hot water consumption (gallons/day)

365 = Conversion: days per year

ρ_{H20} = Density of water (8.33 lb/gal)

Cp_{H20} = Specific heat of water (1 Btu/lb/°F)

T_{WH} = Water heater temperature set-point

T_{in} = Temperature of inlet water

$EF_{Federal\ Standard}$ = Energy factor for federal standard electric water heater

EF_{Rated} = Energy factor for ENERGY STAR heat pump water heater

One major difference in savings estimation from *ex-ante* to *ex-post* is that the evaluation team used field measurements, such as actual rated energy factor as opposed to the minimum value required for ENERGY STAR certification and actual hot water temperature set-points. Unlike other measures, the evaluation team did not apply an *in situ* adjustment using metered data, primarily due to the uncertainties created by technological differences between a baseline unit, assumed to be an electric resistance water heater, and an efficient unit, which is a heat pump water heater.

The evaluation team contemplated using an in-service rate factor to account for heat pump water heaters that were rebated but not installed and operating. Based on the results of the participant survey, the evaluation team determined an adjustment was not needed. Of the 80 participants surveyed who received a rebate for a heat pump water heater, only three responded that the new heat pump water heater was not operating at the time of the survey. All three respondents indicated that the heat pump water heater would be installed within the month. A breakdown by rebate amount is presented in Table 2-34.

Table 2-34: Heat Pump Water Heater In-Service Survey

Response	All Units
Unit is operating	77
Unit is not operating	3
…If not, unit will be operating in 1 month	3
No Response	0
TOTAL RESPONDENTS	**80**

The evaluation team utilized several sources as assumptions for the savings algorithm. The average outlet water temperature was defined as the water heater temperature set-point, which was typically read off of the heat pump water heater unit. After mapping units to the QPL, the evaluation team was able to calculate the database average energy factor and rated kWh. These assumptions are presented in Table 2-35.

Table 2-35: Heat Pump Water Heater Assumptions

Parameter	Value	Source
Gallons per Day (GPD)	51.1	2014 TRM
Outlet Water Temperature (T_{WH})	126.2	Sample Average (n=20)
Inlet Water Temperature (T_{in})	50.8	2014 TRM
Federal Minimum Energy Factor	0.91	NAECA
Rated Energy Factor	2.39	Database Average
Rated Energy Consumption	1,831	Database Average

The evaluation team derived the per unit kWh savings for heat pump water heaters. The derivation is as follows:

$$\Delta kWh = \frac{51.1 \times 365 \times 8.33 \times 1 \times (126.2 - 50.8)}{3413} \times \left(\frac{1}{0.91} - \frac{1}{2.39}\right)$$

$$\Delta kWh = 2{,}335.70 kWh$$

Compared to the *ex-ante* savings value and the 2014 TRM value, this number is slightly higher. The higher efficiency levels observed in the program increase the savings estimate, which is counteracted by the lower temperature set-point of the water heaters. With more sophisticated water heaters including LED displays, customers may be more apt to turn down temperature set-points compared to a traditional water heater without a display.

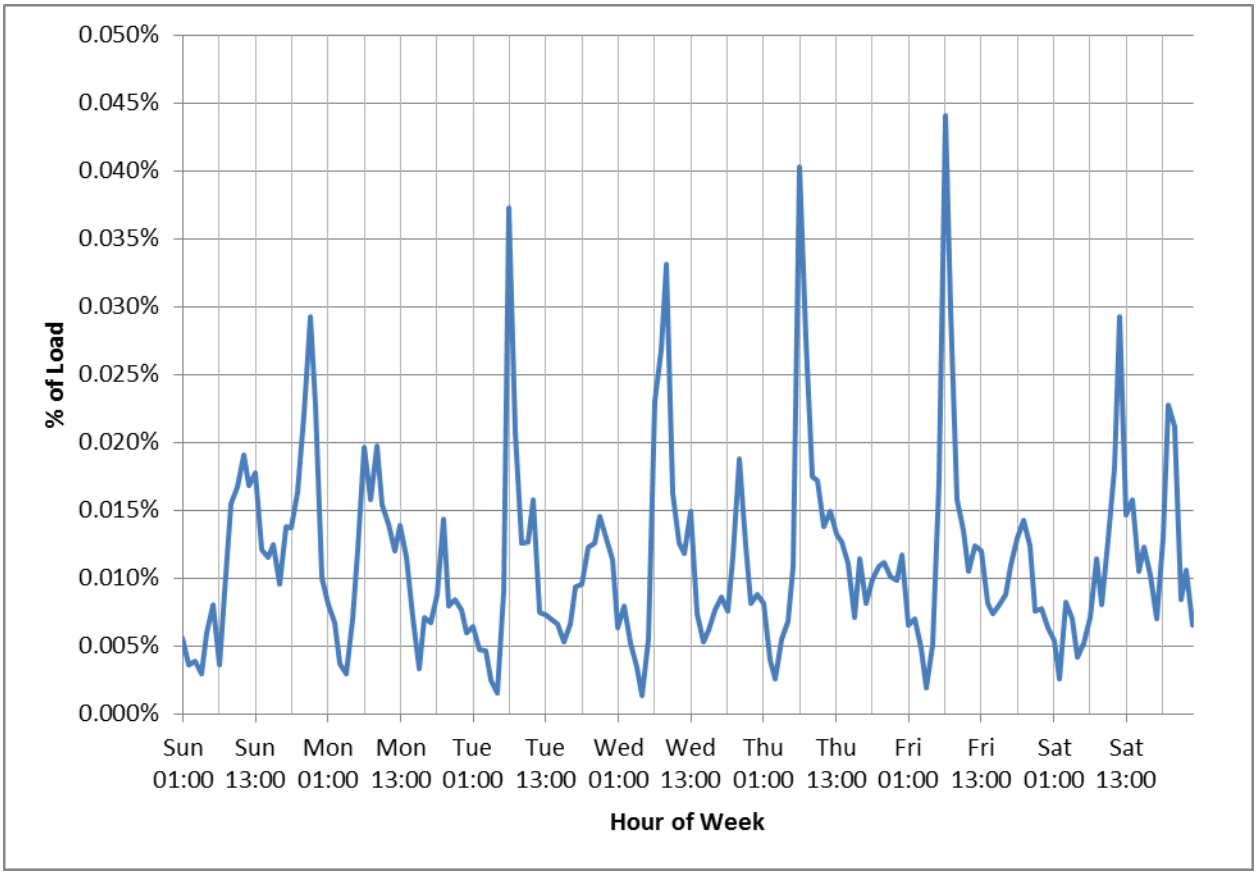
A Massachusetts evaluation report on heat pump water heaters found savings that ranged between 1,687 and 2,670 kWh annually over a standard efficiency electric resistance water heater (0.91 EF).[56] It is curious to note that the report findings seem to suggest that the GE heat pump water heaters have lower overall efficiency than other models. The sample for this evaluation (as well as the program population) consists mostly of GE heat pump water heaters.

[56] Heat Pump Water Heaters Evaluation of Field Installed Performance, June 2012. Page 2. http://www.ma-eeac.org/Docs/8.1_EMV%20Page/2012/2012%20Residential%20Studies/MA%20RR&LI%20-%202011%20HPWH%20Field%20Evaluation%20Report%20FINAL%206_26_2012.pdf

2.1.4.3 Demand Savings

The evaluation team developed a weekly 168-hour load shape using metered data. In theory, water heater operation may change from season to season, given that ground water temperatures may vary slightly, but the evaluation team would need to collect sufficient water temperature data across multiple months to create a load shape that was appropriately adjusted for seasonal differences. Regardless, the evaluation team believes this model is sufficient because it uses an annual average of ground water temperature that is representative of annual consumption. The load shape is presented in Figure 2-12.

Figure 2-12: Heat Pump Water Heater Weekly Load Profile



The evaluation team calculated peak demand savings by first applying the generated load profile to the annual energy savings to determine average hourly demand savings and then isolating the ISO-NE peak hours. The resultant unit peak demand savings is 0.1860 kW.

The load profile follows traditional wisdom that hot water is consumed primarily for showers during weekday mornings with secondary spikes in the evenings. Spikes around 7:00AM are observable for each of the weekdays, while profiles are flatter on the weekends.

2.1.4.4 Decision Type Analysis

The evaluation team was able to interview 19 participants who received a rebate for a heat pump water heater. Because most of the old water heaters were removed from the property after the installation of the new rebated water heater, the evaluation team relied on self-reports from the participant. Average ages are presented in Table 2-36.

Table 2-36: Previous Water Heater Average Life

Previous Water Heater Age[1]	Average Age (years)	Respondents (n)
5 Years Old or Less	2.7	3
Less than 10 Years Old but More than 5 Years Old	7.6	5
More than 10 Years Old	23.8	7
Could Not Recall	N/A	4
ALL PREVIOUS WATER HEATERS[2]	**14.2**	**15**

[1] Ten years is used as the cut-off because the effective useful life for heat pump water heater is 10 years.
[2] Does not include the 4 non-responses in the total.

Given that water heaters have a 10 year effective useful life (according to the Maine TRM), any unit over 10 years old exceeds its useful life. Rebated heat pump water heaters replacing water heaters exceeding useful life represent a new or replacement scenario. The evaluation team defined water heaters that were 10 years old or less as water heaters with remaining useful life; these units could be considered as early replacement scenarios.

Based on these 15 interview responses, approximately 53% of heat pump water heaters could be considered early replacement. With a more conservative estimate that defines early replacement as a situation where the replaced unit still has more than half its effective useful life remaining, this figure drops to 20%.

Some consideration should also be given to the fact that many of the on-site participants converted from other fuel types when installing the heat pump water heater. Of the 19 participants interviewed, two reported having an electric water heater and two others reported having a propane water heater prior to installing the heat pump water heater. The remaining 15 converted from oil-fired water heating systems. Due to the possibility of fuel switching, the decision regarding an appropriate baseline is more complicated than for other measures. For the purposes of this evaluation, the team assumes that customers had already decided to switch to electric water heating.

2.1.4.5 Savings Summary

Through metering and analysis activities, the evaluation team calculated unit *ex-post* savings values, presented in Table 2-37.

Table 2-37: Heat Pump Water Heater *Ex-Post* Savings Assumptions

Measure Name	Unit Peak kW Savings	Unit kWh Savings
Heat Pump Water Heater	0.1860	2,335.70

To calculate the total gross *ex-post* for heat pump water heaters, the evaluation team applied the unit *ex-post* savings to all eligible heat pump water heaters. There were no ineligible heat pump water heaters incented by the program. The gross ex-post savings were calculated by applying the *ex-post* savings values to eligible heat pump water heaters. Realization rates are expressed as the gross *ex-post* savings divided by the gross *ex-ante* savings. A summary of results for heat pump water heaters is presented in Table 2-38.

Table 2-38: Heat Pump Water Heater Savings Summary

Savings Type	Peak kW Savings	kWh Savings
# of Units Rebated	281	281
Gross *Ex-Ante* Savings	24.7	622,134
# of Units Eligible	281	281
Gross *Ex-Post* Savings	52.3	656,332
Realization Rate	211.3%	105.5%
Relative Precision at 90% Confidence	N/A	N/A
Relative Precision at 80% Confidence	N/A	N/A
Coefficient of Variance (Cv)	N/A	N/A

2.1.5 Non-Priority Measures

In addition to the four priority measures, the Appliance Rebate Program also provided rebates for four other measures, herein called *non-priority measures*: Room Air Conditioners, Air Purifiers, Electric Resistance Water Heaters, and Freezers. Similar to eligibility requirements for the priority measures, non-priority appliances certified as ENERGY STAR were generally eligible for a rebate. Because the overall savings contribution of these measures was very low, the evaluation team performed a basic review of the program database and algorithms.

The *ex-ante* savings assumptions for air conditioners, air purifiers, and freezers were sourced from the ENERGY STAR appliance calculator, accessed in 2012. As with most measures in that calculator, assumptions for these measures have been revised since 2012. Almost all changes in the calculator have led to smaller estimates because the calculator in 2012 assumes efficiency levels slightly better than the ENERGY STAR minimum requirements whereas the calculator available in January 2014 assumes the ENERGY STAR minimum requirements for the efficient case. For example, the 2012 calculator assumes that an ENERGY STAR refrigerator is 22% better than the federal code whereas the 2014 calculator assumes that an ENERGY STAR refrigerator is only 20% better than federal code. The *ex-ante* savings assumptions for electric resistance water heaters are sourced from the Efficiency Maine Trust Baseline Opportunities Study[57] conducted in 2012. Savings assumptions are presented in Table 2-39.

Table 2-39: Non-Priority Measure *Ex-Ante* Savings Assumptions

Measure Name	Unit kW Savings	Unit Peak kW Savings	Unit kWh Savings
Air Conditioner	0.008	0.0067	30
Air Purifier	0.128	0.0854	230
Electric Resistance Water Heater	0.081	0.0078	196
Freezer	0.022	0.0152	83

Based on the measurement and verification activities conducted for the four priority measures, which result in savings estimates similar to the ENERGY STAR calculators for refrigerators, clothes washers and dehumidifiers, the evaluation team believes that the ENERGY STAR calculators generally report savings in the appropriate range and therefore that *ex-ante* savings assumptions are reasonable. Although Efficiency Maine has revised savings values in the 2014 TRM to reflect current ENERGY STAR calculators, the evaluation team does not find reason to adjust FY2013 savings without further in-depth analysis that is out of the scope of this evaluation. Without conducting additional metering activities, the evaluation team also agrees with the generation of demand savings using historical data.

[57] EMT Baseline Opportunities Study, September 2012.

2.1.5.1 Savings Summary

The evaluation team is assigning *ex-post* savings equal to the *ex-ante* savings assumptions in order to calculate the savings for the non-priority measures. Because the realization rate is 100% and from a statistical sense can be described as one stratum, the evaluation team condensed the non-priority measures into one category. Savings are presented in Table 2-40.

Table 2-40: Non-Priority Measures Savings Summary

Savings Type	Peak kW Savings	kWh Savings
# of Units Rebated	1,807	1,807
Gross *Ex-Ante* Savings	22.3	127,621
# of Units Eligible	1,807	1,807
Gross Adjusted *Ex-Ante* Savings	22.3	127,621
Gross *Ex-Post* Savings	22.3	127,621
Realization Rate	100.0%	100.0%
Relative Precision at 90% Confidence	N/A	N/A
Relative Precision at 80% Confidence	N/A	N/A
Coefficient of Variance (Cv)	N/A	N/A

2.2 Net Savings Analysis

The evaluation team estimated net savings values in order to determine savings attributable to the program. Freeridership and spillover, two components of the net-to-gross (NTG) ratio, were calculated based on results from the participant telephone surveys.

2.2.1 Freeridership

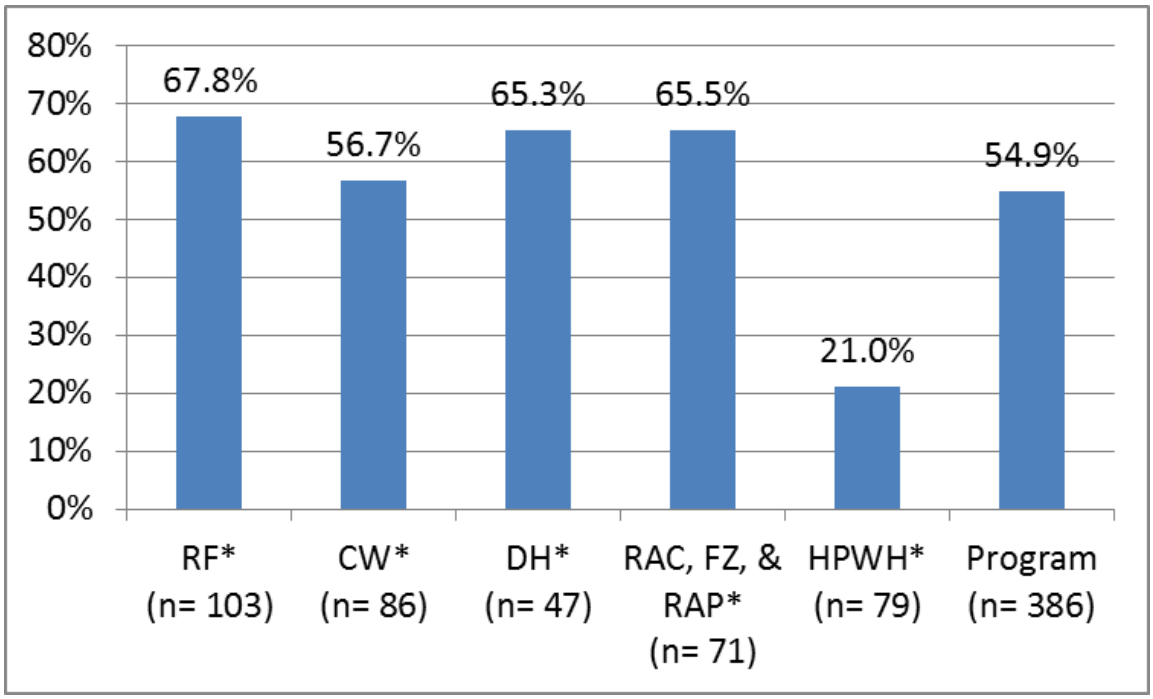
In order to calculate freeridership values for each of the appliance types, interviewed participants were asked a series of questions designed to assess the influence of the program rebate on their decision to purchase their particular appliance model. The team employed the following algorithm in the order of priority listed below:

- If a survey respondent was unaware of the rebate at the time of purchase (see Table A-2) then freeridership equals 100%. If a respondent was not aware of the rebate at the time that the purchase decision was made, then the rebate could not have affected their purchase decision.
- If a respondent said they would have purchase the same appliance at a later date (see Table A-14), mentioned the Efficiency Maine rebate as a secondary reason for purchasing the appliance (see Table A-8), or the sales person influenced their decision by mentioning the Efficiency Maine rebate (see Table A-12), the freeriderhip was capped at a maximum of 50%. Each of these situations indicates that the rebate had at least a partial effect on their purchase decision.

- If a respondent would have purchased a lower efficiency model without the rebate (see Table A-16), then freeridership equals 0%. This response indicates that the rebate had a clear impact on the decision regarding the efficiency level of the appliance.
- If a respondent would not have purchased an appliance at all without the rebate (see Table A-15) then freeridership equals 0%. This response indicates that the rebate had a clear impact on the decision regarding the model selection.
- If a respondent mentioned the Efficiency Maine rebate as the primary reason for purchasing the appliance (see Table A-7) then freeridership equals 0%. This response indicates that the rebate had a clear impact on their decision regarding the model selection.
- For all other respondents that do not meet any of the above criteria, freeridership equals 100% - (10% x Importance Rating) (see Table A-17). For example, if a respondent rated the importance of the rebate as an 8 out of 10, then their freeridership rate would equal 20%.

Applying the above algorithm, we calculate a freeridership rate of between 56% and 68% for each of the appliance types, with the exception of heat pump water heaters (21%). The program-level freeridership rate, weighted by (1) the relative proportion of rebates-to-surveys and (2) the fact that appliances yield different savings values, is estimated to be 54.9%.

Figure 2-13: Participant Freeridership Rate



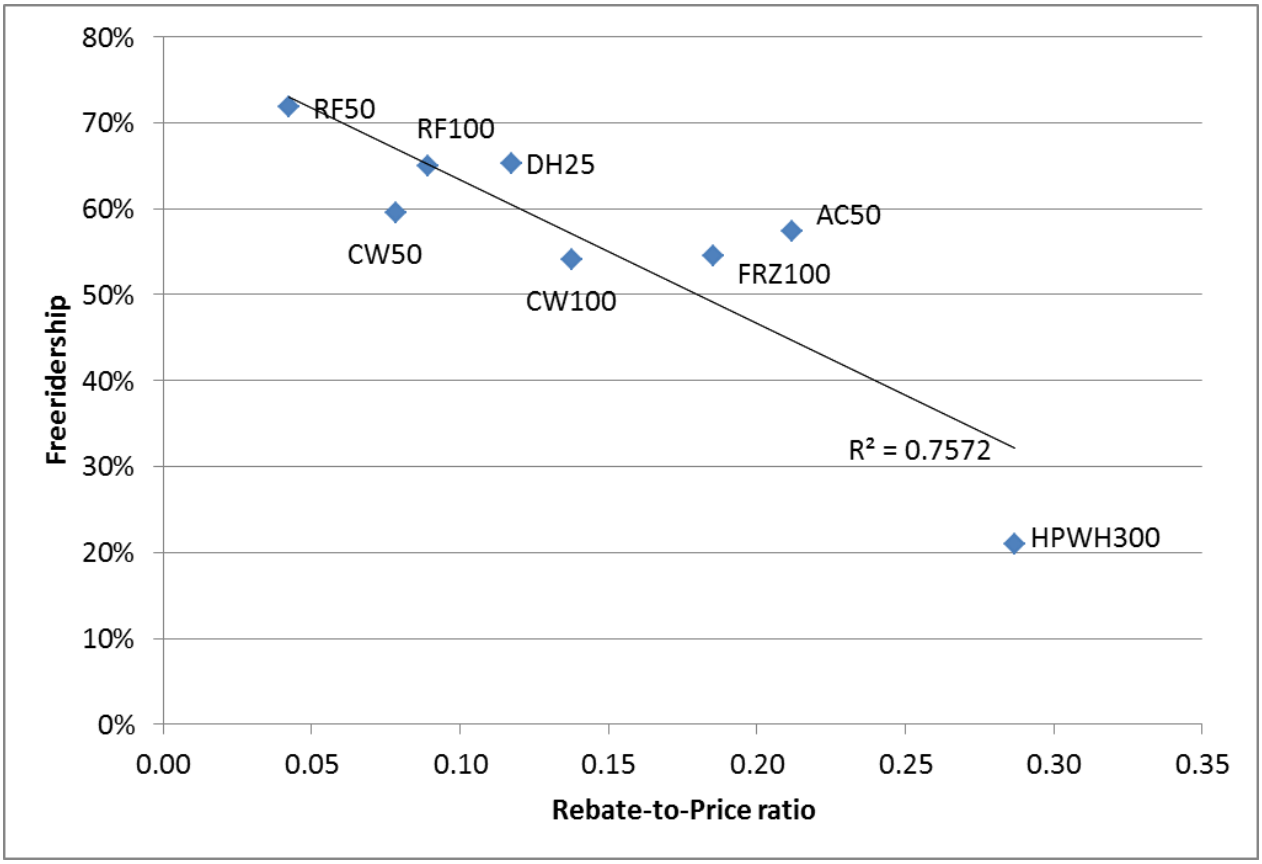
*RF=Refrigerator; CW=Clothes washer; DH=Dehumidifier; RAC, FZ, & RAP = Room air conditioner, Freezer, and Room air purifier; HPWH = Heat pump water heater

The freeridership rate is largely driven by the fact that 39% of participants said they were not aware of the rebate at the time they purchased their appliance (see Figure 3-2), therefore their freeridership rate equals 100%. Because 84% of participants reported learning of the rebate while at the store (see Figure 3-1) it is likely that some customers may simply learn of the rebate after already deciding which model to purchase. Because the program has not been offered consistently, and therefore has not developed a stable presence in the market, it seems reasonable to expect that most people would first learn of the rebate while visiting a store. In addition, because some respondents shop online before visiting a store, it is possible that a portion of respondents have already decided on their model before even entering a store. In particular, participants are less likely to speak with a sales person regarding dehumidifiers and room air conditioners, which means they may also be less likely to learn of the rebate until after already making their purchase decision.

While the program considers incremental costs when calculating rebate levels, customers more likely consider the overall purchase cost. Because the program offers rebates that are relatively small compared to the purchase price for refrigerators (4%-9%), clothes washers (8%-14%), and dehumidifiers (12%), it seems reasonable that the rebate may have little influence on purchase decisions (Figure 2-14). In addition, ENERGY STAR appliances have been available in the market for some time and are generally widely available at retail stores. All of these factors may contribute to the high freeridership rate.

In contrast, only 18% of heat pump water heater respondents were *not* aware of the rebate when they purchased their heat pump water heater, fewer (52%) had first learned of the rebate at the store, the rebate-to-price ratio for heat pump water heaters is the highest (29%), the rebate ($300) is triple the value of the next highest rebate, and the technology itself is relatively new to the market. All of these factors may contribute to the substantially lower freeridership rate found for heat pump water heaters.

Figure 2-14: Participant Freeridership rate by Rebate-to-Price ratio*



*RF50 = Refrigerator $50 rebate (n=43), RF100 = Refrigerator $100 rebate (n=61), CW50 = Clothes washer $50 rebate (n=41), CW100 = Clothes washer $50 rebate (n=44), DH25 = Dehumidifier $25 rebate (n=47), AC50 = Room air conditioner $50 rebate (n=49), FRZ100 = Freezer $100 rebate (n=18), HPWH300 = Heat pump water heater $300 rebate (n=79)

These freeridership numbers are similar to estimates found in a 2012 evaluation of an appliance rebate program conducted for NYSERDA. This study found freeridership rates of 62% for refrigerators ($75 rebate), 49% for clothes washers ($75 rebate), and 40% for freezers ($50 rebate).[58] In addition, the NYSERDA report noted that other non-public studies had found

[58] NYSERDA American Reinvestment and Recovery Act 2012 Impact Evaluation Report: State Energy Programs. Prepared for NYSERDA. Prepared by The Cadmus Group, Abt SRBI , Beacon Consultants, Energy & Resource Solutions, Navigant Consulting, and NMR Group. April 30, 2012.

similar rates of freeridership. Lastly, a CPUC report from 2010 also found similar freeridership values for clothes washers – 69% to 71%.[59]

It is also worth noting that the NYSERDA report found substantially lower freeridership (15%) for an option where participants purchased multiple ENERGY STAR appliances (including a refrigerator, clothes washer, and dishwasher) that met CEE Tier requirements and in return received a large rebate of $500.

2.2.2 Participant Spillover

In order to estimate the level of participant spillover produced by the program, interviewed participants were asked a series of questions designed to assess the influence of the program rebate on their decision to purchase additional energy efficient products. The team employed the following algorithm:

- The participant reported purchasing an energy-efficient product without an Efficiency Maine rebate after participating in the Appliance Rebate Program (see Table A-19)
- The respondent reported that the product was ENERGY STAR qualified[60] (see Table A-20)
- The product yields electricity savings according to the 2013 or 2014 Maine TRM
- The respondent rated the importance of the program in the purchase decision as a one or greater on a 10-point scale (see Table A-22)

For example, assume a respondent purchased a clothes washer through the Appliance Rebate program. In the survey, this respondent reported purchasing, since participating in the Appliance Rebate program, an ENERGY STAR refrigerator that did not receive any type of Efficiency Maine rebate. This respondent rated the importance of the program rebate as a four on a ten-point scale in terms of influencing the decision to purchase the ENERGY STAR refrigerator. This evaluation estimates annual electricity savings of 128 kWh for ENERGY STAR refrigerators. Therefore, the estimated spillover savings is 40% x 128 kWh equals 51 kWh.

Applying the approach outlined above, we estimate that 23 of the 382 survey participants (6.0%) yield spillover from the program. The spillover savings from the 27 products purchased by these 23 respondents represent 3.3% of the annual electricity savings from all 397 program-rebated appliances purchased by all 382 survey respondents.

Because the sample sizes are small, we only calculate spillover for the entire program, rather than separately for each appliance type. It is important to note that this estimate of spillover is conservative because respondents had, at most, a one year window in which to purchase

[59] Residential Retrofit High Impact Measure Evaluation Report. Prepared For The California Public Utilities Commission, Energy Division. Prepared by The Cadmus Group, Itron, Jai J. Mitchell Analytics, KEMA, PA Consulting Group, and Summit Blue Consulting. February 8, 2010.

[60] Because the survey did not ask for the quantity of products purchased since program participation, the team assumed one unit was purchased for each product with the exception of CFLs & LEDs where three bulbs were assumed.

additional energy efficiency products. In addition, this estimate does not reflect nonparticipant spillover.

2.2.3 Net-to-Gross Ratio

NTG ratios are calculated for each appliance type by the following equation:

$$NTG = 1 - Freeridership(\%) + Spillover(\%)$$

Freeridership, spillover, and the resulting NTG are all presented in Table 2-41.

Table 2-41: Program Net-to-Gross Ratios

Measure	Free Ridership	Spillover	NTG Ratio
Refrigerators	67.8%	3.3%	35.5%
Clothes Washers	56.7%	3.3%	46.6%
Dehumidifiers	65.3%	3.3%	38.0%
Heat Pump Water Heaters	21.0%	3.3%	82.3%
Room ACs, Freezers, & Room Air Purifiers	65.5%	3.3%	37.8%
Overall Program (weighted)	*54.9%*	*3.3%*	*48.4%*

2.2.4 Net Savings

To calculate net savings, the evaluation team applied the NTG to the gross savings, as described by the following equation:

$$Net\ Savings = Gross\ Savings \times NTG$$

Net savings for each measure are presented in Table 2-42.

Table 2-42: Program Net Savings

Measure	Net Energy Savings	Net Peak Demand Savings
Refrigerators	378,028	44.2
Clothes Washers	1,610,028	237.6
Dehumidifiers	56,016	12.8
Heat Pump Water Heaters	540,161	43.0
Room ACs, Freezers, & Room Air Purifiers	48,241	8.4

2.3 Program Level Savings

The evaluation team aggregated the results from the gross and net savings analysis at the program level. The first year annual kWh savings are presented for gross and net savings in Table 2-43. The overall program gross realization rate for energy is 101.4% and the overall program gross realization rate for demand is 191.2%. The overall program net realization rate for energy is 47.1% and the overall program net realization rate for demand is 86.8%.

Table 2-43: First Year Annual kWh Savings

Stratum	Gross Ex-Post kWh Savings	Net Ex-Post kWh Savings	Relative Precision at 90% Confidence	Relative Precision at 80% Confidence
Refrigerator	1,064,867	378,028	9.3%	7.2%
Clothes Washer	3,454,995	1,610,028	11.7%	9.1%
Dehumidifier	147,410	56,016	3.4%	2.7%
Heat Pump Water Heater	656,332	540,161	0%	0%
Non-Priority Measures	127,621	48,241	0%	0%
OVERALL	**5,451,225**	**2,632,473**	**9.4%**	**7.4%**

The lifetime kWh savings are presented for gross and net savings in Table 2-44.

Table 2-44: Lifetime kWh Savings

Stratum	Measure Life[1]	Lifetime Gross kWh Savings	Lifetime Net kWh Savings
Refrigerator	12	12,778,405	4,536,334
Clothes Washer	11	38,004,941	17,710,303
Dehumidifier	12	1,768,921	672,190
Heat Pump Water Heater	10	6,563,317	5,401,610
Non-Priority Measures	Various[2]	1,290,186	487,690
OVERALL	**N/A**	**60,405,771**	**28,808,127**

[1] Measure lives are taken from Efficiency Maine 2013 TRM

[2] The measure lives for other measures are as follows: air conditioner (9), air purifier (9), electric resistance water heater (10), and freezer (12).

The summer peak savings are presented for gross and net savings in Table 2-45.

Table 2-45: Summer Peak kW Savings

Stratum	Gross Ex-Post kW Savings	Net Ex-Post kW Savings	Relative Precision at 90% Confidence	Relative Precision at 80% Confidence
Refrigerator	124.6	44.2	9.3%	7.2%
Clothes Washer	509.9	237.6	11.7%	9.1%
Dehumidifier	33.8	12.8	3.4%	2.7%
Heat Pump Water Heater	52.3	43.0	0%	0%
Non-Priority Measures	22.3	8.4	0%	0%
OVERALL	**742.8**	**346.1**	**9.4%**	**7.4%**

2.4 Cost-Effectiveness Analysis

The evaluation team calculated the cost-effectiveness of the program using the total resource cost (TRC) and program administrator cost (PAC) tests. Inputs for the model were provided by Efficiency Maine and included the following:

- Avoided Energy Costs (including 2014 DRIPE)
- Avoided Capacity Costs (including avoided T&D costs)
- Line Loss Multiplier
- Discount Rate
- Program Costs
- Incentive Amounts

The avoided energy and capacity costs provided by Efficiency Maine were sourced from Appendix B of the AESC 2013 report.[61] Regarding the capacity costs, the AESC 2013 report states the following:

> "There is a loss of electricity between the generating unit and ISO-NE's delivery points, where power is delivered from the ISO-NE administered pooled transmission facilities (PTC) to the distribution utility local transmission and distribution systems. Therefore, a kilowatt load reduction at the ISO-NE's delivery points, as a result of DSM on a given distribution network, reduces the quantity of electricity that a generator has to produce by one kilowatt plus the additional quantity that would have been required to compensate for losses. The energy prices forecast by the Market Analytics model reflect these losses. However, the forecast of capacity costs from the FCM do not." [62]

[61] Avoided Energy Supply Costs in New England: 2013 Report, July 2013. http://www.synapse-energy.com/Downloads/SynapseReport.2013-07.AESC.AESC-2013.13-029-Report.pdf
[62] AESC 2013 Report, Page 5-41

Because these losses were not included in the FCM forecasted capacity costs, the evaluation team included an additional avoided transmission and distribution cost of $80,000 kWh/year in the calculation of avoided capacity costs.[63] The evaluation team notes that the cost-effectiveness ratios presented here are higher than the comparable (ex-ante gross) results presented in the Efficiency Maine annual report[64] largely due to higher estimated ex-ante gross TRC benefits in our analysis.

The program costs refer to costs of delivering the program and do not include participant costs or incentive costs. The evaluation team notes that this distinction is important for properly calculating the TRC and PAC ratios.

The following inputs were provided by the 2013 TRM:

- Measure Life
- Incremental Cost
- Energy Period Factors

The four energy periods are defined by ISO-NE, presented in Table 2-46. These factors are applied to measure level savings to spread energy savings across one of the four periods. These periods also correspond with the avoided energy costs provided by Efficiency Maine.

Table 2-46: ISO-NE Energy Periods

Energy Period	Months	Times
Winter On Peak	October through May	Non-Holiday Weekdays 7:00AM to 11:00PM
Winter Off Peak		Non-Holiday Weekdays 11:00PM to 7:00AM
		Holidays and Weekend Hours All Hours
Summer On Peak	June through September	Non-Holiday Weekdays 7:00AM to 11:00PM
Summer Off Peak		Non-Holiday Weekdays 11:00PM to 7:00AM
		Holidays and Weekend Hours All Hours

[63] Email from Ian Burnes (Efficiency Maine), January 2014.
[64] http://www.efficiencymaine.com/docs/2013-Efficiency-Maine-Annual-Report.pdf

In light of the high freeridership results, the evaluation team calculated cost-effectiveness using both gross savings and net savings. Gross and net savings are generated from the analysis completed in Sections 2.1 and 2.2. With this data at hand, the evaluation team was able to calculate the TRC and PAC ratios. This analysis was conducted at the gross *ex-ante*, gross *ex-post*, and net *ex-post* levels. The resultant program-level TRC ratios are presented in Table 2-47. The Efficiency Maine 2013 annual report stated that the benefit to cost ratio of the program was 1.51.

Table 2-47: Program Cost Effectiveness Ratios

Savings Type	TRC Ratio	PAC Ratio
Gross *Ex-Ante* Savings	1.91	2.32
Gross *Ex-Post* Savings	3.41	4.15
Net *Ex-Post* Savings	1.73	1.96

The evaluation team also calculated cost-effectiveness at the measure level, presented in Table 2-48 for TRC and Table 2-49 for the PAC. These ratios do not include program costs, which are added to the costs at the program level. If program costs were distributed to the individual measures, measure level cost-effectiveness would decrease.

Table 2-48: Measure Level TRC Ratios

Measure	Gross *Ex-Ante* TRC	Gross *Ex-Post* TRC	Net TRC
Air Conditioner	0.48	0.48	0.20
Air Purifier[1]	N/A	N/A	3.50
Clothes Washer	1.98	4.80	3.15
Dehumidifier	15.24	9.36	3.06
Electric Water Heater	1.42	1.42	1.15
Freezer	9.58	9.58	0.57
Heat Pump Water Heater	2.05	2.36	2.20
Refrigerator	3.58	3.14	0.67

[1] TRC ratios are N/A because the incremental cost is $0. Without any costs, the benefit cost ratio cannot be calculated. For the net TRC ratio, costs paid to freeriders in the form of incentives represent the denominator and allow the evaluation team to perform the calculation.

Table 2-49: Measure Level PAC Ratios

Measure	Gross *Ex-Ante* PAC	Gross *Ex-Post* PAC	Net PAC
Air Conditioner	0.48	0.48	0.20
Air Purifier	5.41	5.41	2.29
Clothes Washer	4.05	9.83	4.58
Dehumidifier	12.19	7.49	2.84
Electric Water Heater	1.32	1.32	1.08
Freezer	0.96	0.96	0.39
Heat Pump Water Heater	4.65	5.36	4.41
Refrigerator	1.81	1.59	0.56

3 Process Evaluation

The process evaluation section integrates the findings from the telephone interviews with program staff and participating store managers, as well as the telephone surveys conducted with program participants.

3.1 Program Operation

The implementation contractor APT recruits stores to participate in the program, including both chain and independent retailers listed in Table 1-18. Retailers sign a participation agreement that requires they understand how the program operates and the measures that are eligible. In addition, they are required to allow APT to train their staff and place POP materials in the store. Lastly, the retailers must agree to allow Efficiency Maine the opportunity to review advertising if it incorporates the Efficiency Maine logo or rebate.

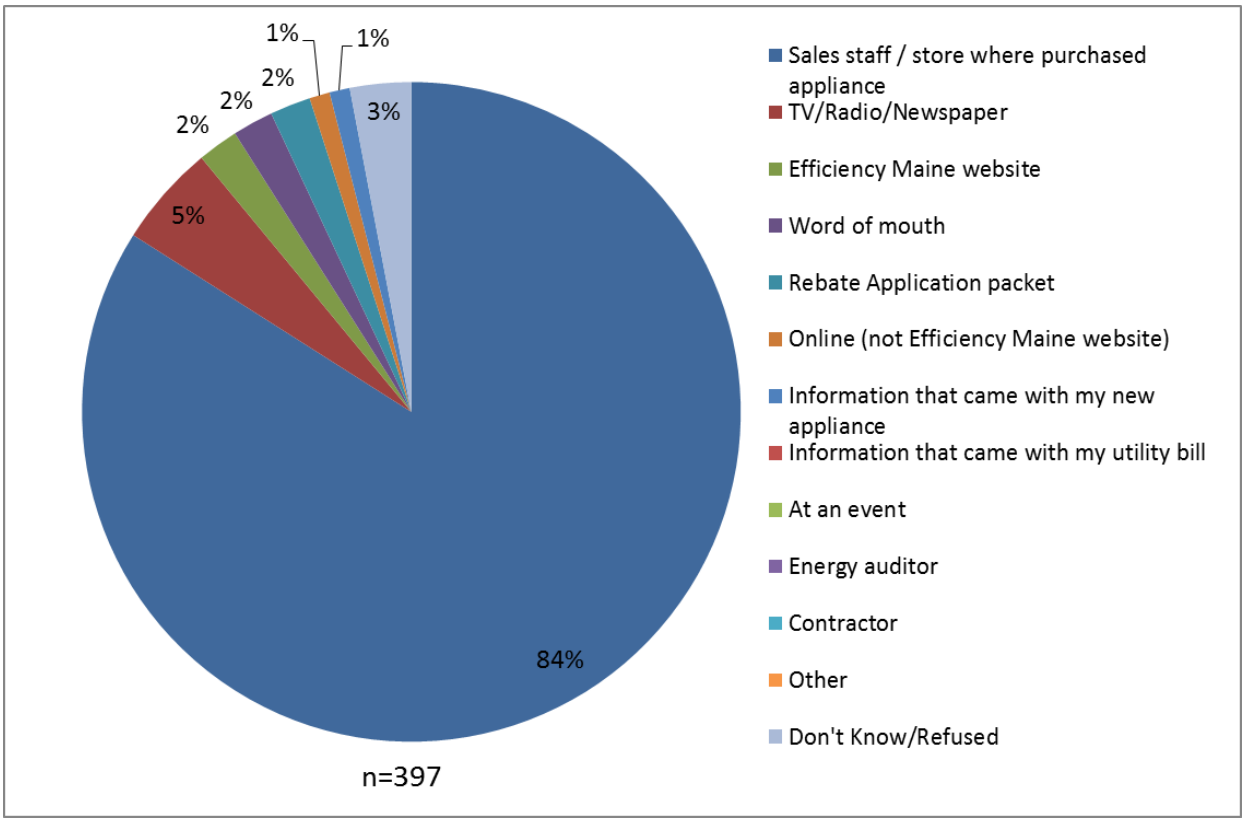
In a typical visit to a store, the field staff may place POP materials, restock rebate forms, explain eligibility criteria, identify qualifying models, and answer any questions from retail staff. In addition, depending on the needs of the particular store, training may cover, among other issues, the details of the rebate application process, the time to receive rebates, the benefits of qualifying appliances; a program manual provides detailed information on these topics. The frequency of store visits depends on their level of participation and needs; some stores are visited weekly, while others are visited quarterly.

After a customer purchases a qualifying appliance, they complete the rebate application and mail it, along with a copy of the receipt, to Energy Federation Inc. (EFI) for processing. EFI determines the eligibility of the appliance, and mails out the rebate check within four to six weeks after receipt. In the event that there are problems with the rebate application, EFI mails a letter to the customer explaining the situation and offers them an opportunity to rectify it.

3.1.1 Awareness of Program

Nearly all participants (84%) reported learning about the rebates at the store where they purchased the appliance, either from the sales staff or from signs/displays (Figure 3-1). This finding demonstrates the importance of in-store materials and staff in promoting the program. Notably, however, a smaller percentage (52%) of those participants who had purchased heat pump water heaters reported learning about the rebates at the retail store. Instead, respondents who had purchased heat pump water heaters were more likely to report learning about the rebates through word of mouth from a friend, coworker or neighbor (15%) or through the Efficiency Maine website (14%).

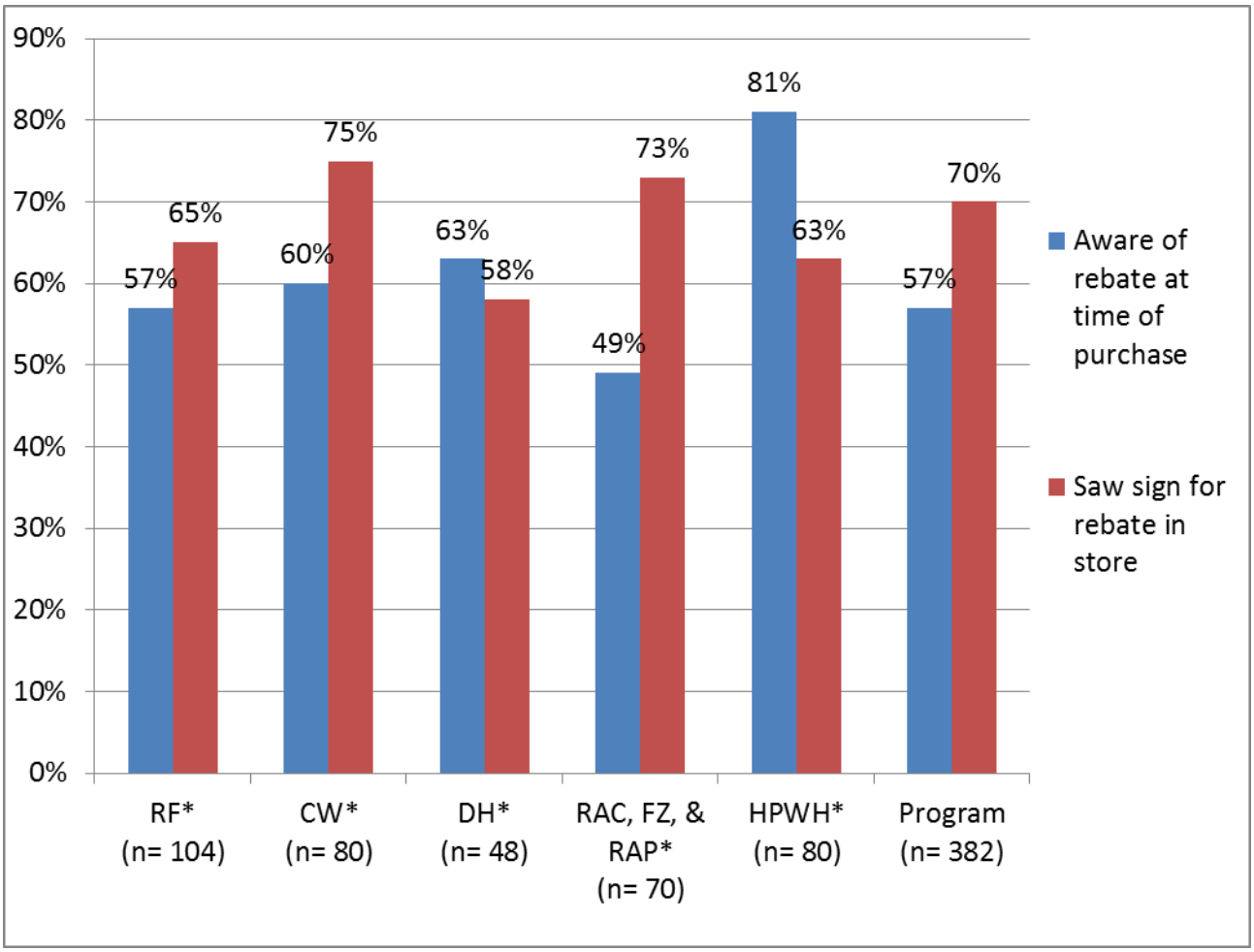
Figure 3-1: How Participants Learned of Program



When asked if they had been aware that Efficiency Maine offered rebates for ENERGY STAR models *when* they purchased their new appliance, nearly two thirds of all participants (57%) said they had been aware of the rebates and 39% were not aware. The lowest awareness (49%) is for the smaller appliances such as room ACs, freezers, and air purifiers while the highest awareness was 81% for heat pump water heaters (Figure 3-2). These results indicate that while many customers (84%) learned of the rebate while at the store, a portion of them (39%) did not learn of the rebate until after deciding which model to purchase.

As an indication of the visibility of point-of-purchase and end-cap signage in stores, 70% of all participants recalled seeing Efficiency Maine signs that mentioned the rebate at the store where they purchased their new appliance.

Figure 3-2: Participant Awareness of Rebate & Signs



*RF=Refrigerator; CW=Clothes washer; DH=Dehumidifier; RAC, FZ, & RAP = Room Air conditioner, Freezer, and Room air purifier; HPWH = Heat pump water heater

3.1.2 Store Manager Motivations to Participate

The eleven interviewed store managers were asked why their stores chose to participate in the program. The six respondents working at national chain retailers explained that the decision was made at the corporate level. Two further respondents working at a smaller chain also said that it was a decision made by higher-ups, but added that "it's a no-brainer." The remaining three respondents, from independent retailers, indicated that if everyone else offers the rebate program, then they have to offer it as well in order to compete.

Store managers were asked to describe their store's commitment to selling ENERGY STAR appliances, and whether that commitment changed as a result of the discontinuation of the rebate program in August 2013. The majority (9 of 11) reported that it is very important for their store to sell ENERGY STAR appliances. Nearly all (10 of 11) indicated that the discontinuation of the program did not change their level of commitment to selling ENERGY STAR models. The respondent who reported that the end of the program changed their commitment mentioned that without the rebate, sales staff would not try to sell high-efficiency models to customers who they observe are interested in the cheapest models.

Table 3-1: Store Manager Commitment to Selling ENERGY STAR Models

Importance of selling ENERGY STAR™ appliances	Count of Respondents
Very important	9
Somewhat important	1
Neither important nor unimportant	1
Did discontinuation of rebates change commitment?	
Yes	1
No	10

3.1.3 Advertising and Promotional Activities

In terms of marketing the program to customers, Efficiency Maine sponsored advertising via print media, newspaper, and, to a lesser degree, radio, in addition to news releases and email blasts to trade allies. In addition, in-store demonstration events were held at some participating retail stores.

Store managers were asked whether they conduct advertising or promotional activities for ENERGY STAR appliances, and if so, what those activities entail. Seven of the eleven interviewees indicated that they promote ENERGY STAR appliances. Of these seven respondents, five indicated that they have referenced the Efficiency Maine appliance rebates in their advertisements or promotional activities, and four reported that their advertising or promotions are different when rebates are available.

The extent to which different types of retailers promoted energy efficient appliances varied. Four of the six respondents at large chain retailers indicated that since advertising and promotional

decisions are made at the corporate level, their involvement in that activity is limited to non-existent. The remaining two chain respondents reported that they make flyers which are distributed with newspapers, and one said that the Efficiency Maine rebate was featured on the flyer. The positioning of appliances on the sales floor or shelves, the number of ENERGY STAR models offered, and the content of advertisements are all determined at the corporate level for all six national chain respondents.

All five of the stores operating only in Maine reported having undertaken advertising and promotional activities. Four of these five stores featured the rebate in their promotional efforts. These respondents mentioned that the rebate is featured on in-store promotional materials, television commercials, and newspaper ads. Three indicated that their promotional efforts are different when the rebate is not available, mentioning that promotions are based on best sellers and therefore different products are featured in the absence of the program.

3.2 Store Manager Perceptions of Sales

In this section we discuss the store manager's perceptions of the programs effect on sales of ENERGY STAR appliances.

3.2.1 General Feedback

Eight of the eleven store managers noticed changes in sales of ENERGY STAR appliances since the rebates were discontinued at the end of August 2013 for refrigerators, clothes washers, dehumidifiers, room air conditioners, freezers, room air purifiers, and electric resistance water heaters. One-half of these eight respondents volunteered that the effect is more pronounced on larger appliances (clothes washers, refrigerators, and water heaters), and five of the eight mentioned that there had been a marked decrease in sales of efficient appliances.

Nevertheless, these respondents did not indicate that the discontinuation of rebates for most appliances (all except HPWH) would affect how their stores stock or display ENERGY STAR appliances. Just two of eleven respondents agreed that the availability of rebates would affect the number of ENERGY STAR models their store offers, and none of the respondents said that the rebate program affects the way they display ENERGY STAR models on their sales floor or shelves. It should be noted that the program is focused on increasing sales, and not necessarily stocking or display practices, of ENERGY STAR appliances.

Table 3-2: Store Manager Assessment of General Program Effects

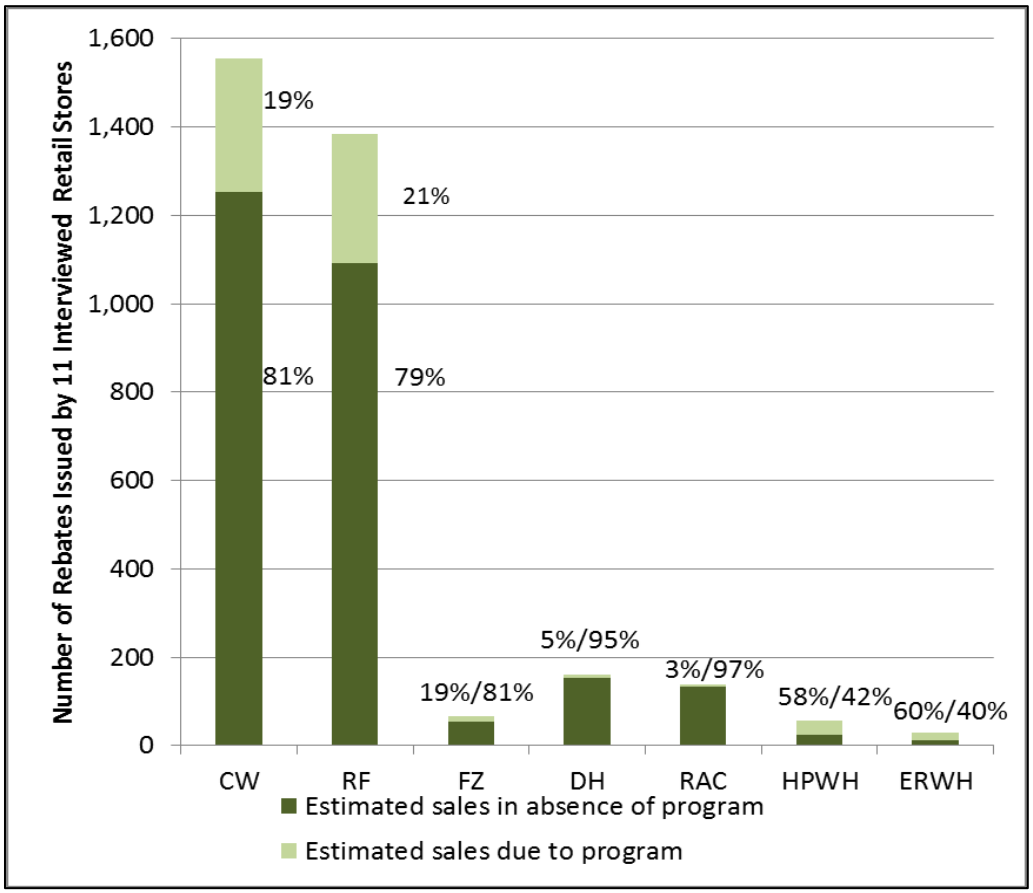
Category	Count of Respondents
Noticed changes in sales of ENERGY STAR™ appliances since rebates were discontinued	8
Mentioned effect is more pronounced on big items	*4*
Mentioned a marked decrease in sales	*5*
Reported that rebates affect positioning/display of ENERGY STAR™ appliances	0
Reported that rebates affect number of ENERGY STAR™ models offered	2

3.2.2 Estimated Sales Due to Program

Program records provided by Efficiency Maine included the number of rebates which the program disbursed to customers of each interviewed retail store, by appliance type. The most commonly-rebated products among the 11 interviewed stores were clothes washers, refrigerators, and dehumidifiers (11 retailers each), with room air conditioners (nine) and freezers (eight) not far behind. Fewer stores had sold heat pump water heaters that received a rebate (six retailers), and still fewer had sold electric resistance water heaters and room air purifiers that received a rebate (three each).

Figure 3-3 presents the 11 store managers' estimates of the scale of the program's influence on sales of ENERGY STAR appliances. The estimated sales attributable to the program are lowest for room air conditioners (3%) and dehumidifiers (5%), though higher for clothes washers (19%), freezers (19%), and refrigerators (21%). The estimated sales attributable to the program are highest for heat pump water heaters (58%) and electric resistance water heaters (60%). These estimates account for the fact that some stores issue a higher volume of rebates than other stores.

Figure 3-3: Store Manager Estimated Sales due to Program



CW=Clothes washer, RF=Refrigerator, FZ = Freezer, DH=Dehumidifier, RAC = Room Air conditioner, HPWH = Heat pump water heater, ERWH = Electric resistance water heater

3.2.2.1 Large Appliances

Overall, store managers stressed that the effects of the program varied based on the significance of the purchase to customers. While customers would accept a rebate on a smaller, point-of-sale item like a room air conditioner or dehumidifier, store managers reported it did not necessarily impact purchase decisions in the same way as rebates did on larger items such as refrigerators or clothes washers.

Table 3-3 details store manager's estimates regarding the sales of large ENERGY STAR appliances (clothes washers, refrigerators, freezers, heat pump water heaters, and electric resistance water heaters) that would have occurred at their stores in the absence of the program.

The most substantial rebate offered by the program during FY2013 is the $300 rebate on heat pump water heaters. Six stores sold heat pump water heaters through the program, for a total of 57 rebates during FY2013. These six store managers estimated that the number of units sold would have been 58% fewer in the absence of the rebate. Store managers reported that the heat pump water heater rebate had a substantial effect on sales (3 of 6 respondents), with one calling it a "ticket to entry" and another saying "As soon as the rebate goes away, we'll stop promoting them".

Eight of the eleven respondents believed that their stores' sales of ENERGY STAR clothes washers and refrigerators would decline in the absence of the rebates. Overall, respondents estimated that FY2013 sales of efficient clothes washers and refrigerators—the two most oft-rebated appliances in the program—would have been lower by 19% and 21%, respectively, without the rebates. When asked their reasons for providing these estimates, store managers most often credited the fact that more interaction with the customer in sales of large appliances helped them to upsell the product, and that customers were driven to purchase more efficient models by the low payback periods which the rebate helped to create.

The number of freezer rebates from the 11 interviewed store locations was less than one-tenth of the number of clothes washer or refrigerator rebates; nonetheless, respondents attribute a similar proportion of freezer sales to the rebate. Six of the eight respondents whose stores sold freezers believe that sales would decline in the absence of the rebates. Store managers reported that, on average, they would have sold 19% fewer ENERGY STAR freezers were it not for the program.

The estimated sales due to the program is similar for both national retailers and Maine-based retailers for clothes washers (16%-23%). However, the estimates vary somewhat more for refrigerators (15%-28%) and freezers (12%-31%), which, as noted above, have far fewer rebates.

High efficiency electric resistance water heaters were rebated less often than other large appliances. Of the eleven interviewees, just three stores had sold electric resistance heaters, for a total of 29 rebates. Those store managers, however, estimated that 60% of those sales were due to the program.

Table 3-3: Store Manager Estimated Impact of Rebate on Large ENERGY STAR Appliance Sales

Detail	Clothes Washers	Refrigerators	Freezers	Heat Pump Water Heater	Electric Water Heater
National Retailers (n=6)					
Number of stores that sold program appliance	6	6	4	3	3
Number reporting sales would have been lower without rebate	4	4	2	2	3
Total number of rebates, all retailers	782	718	43	39	29
Average reported percent lower sales in absence of rebate	16%	15%	12%	44%	60%
Maine-Only Retailers (n=5)					
Number of stores that sold program appliance	5	5	4	3	0
Number reporting sales would have been lower without rebate	4	4	4	3	0
Total number of rebates, all retailers	772	666	24	18	0
Average reported percent lower sales in absence of rebate	23%	28%	31%	89%	n/a
All Respondents (n=11)					
Number of stores that sold program appliance	11	11	8	6	3
Number reporting sales would have been lower without rebate	8	8	6	5	3
Total number of rebates, all retailers	1,554	1,384	67	57	29
Average reported percent lower sales in absence of rebate	19%	21%	19%	58%	60%

When asked for the reasons behind their estimated change in sales of large appliances in the absence of the program, four of eight store managers mentioned that more interaction with the customer helped with the upsell. In addition, three managers mentioned that customers are interested in the payback and/or savings. However, one reported that most clothes washers and refrigerators are ENERGY STAR regardless of the rebates, whereas fewer ENERGY STAR freezers are available, suggesting that the rebates may have more effect on freezers.

3.2.2.2 Small Appliances

Store manager estimates as to the program's impact on sales of small appliances were modest. Even though all 11 respondents had sold dehumidifiers that received rebates from the program, only three respondents believe that their stores' ENERGY STAR sales would decline in the absence of the rebates. On average they estimated that they would have sold just 5% fewer ENERGY STAR units if the rebate for dehumidifiers were not available.

Similarly, only two of the nine respondents that sold room air conditioners believe that their stores' ENERGY STAR sales would have decreased in the absence of the rebates. Overall, these respondents estimated that, on average, sales of ENERGY STAR room air conditioners would have been 3% less in the absence of the rebate program.

Overall, the estimated sales due to the program is similar for national retailers and Maine-based retailers for both dehumidifiers (1%-7%) and room air conditioners (0%-3%).

Table 3-4: Store Manager Estimated Impact of Rebate on Small ENERGY STAR Appliance Sales

Detail	Dehumidifiers	Room A/C
National Retailers (n=6)		
Number of stores that sold program appliance	6	6
Number reporting sales would have been lower without rebate	2	1
Total number of rebates, all retailers	126	119
Average reported percent lower sales in absence of rebate	7%	3%
Maine-Only Retailers (n=5)		
Number of stores that sold program appliance	5	3
Number reporting sales would have been lower without rebate	1	1
Total number of rebates, all retailers	35	19
Average reported percent lower sales in absence of rebate	< 1%	0%
All Respondents (n=11)		
Number of stores that sold program appliance	11	9
Number reporting sales would have been lower without rebate	3	2
Total number of rebates, all retailers	161	138
Average reported percent lower sales in absence of rebate	5%	3%

Most store managers (7 of 10) confirmed that the dehumidifier rebate was not a strong motivator for customers, because dehumidifiers are a point-of-sale purchase and therefore command less consideration from customers than would a larger appliance. This was the most common explanation among sellers of room air conditioners as well (3 of 9), though two managers indicated that the rebate helped with the upsell or was useful for larger models.

3.2.3 Tiered Rebates

During a portion of FY2013, the program offered two rebate tiers for clothes washers: a first-tier rebate of $50 for ENERGY STAR models, and a second-tier rebate of $100 for more efficient ENERGY STAR models with a Modified Energy Factor ≥2.2. Of the 87 program participants who had purchased a rebated clothes washer, nearly two thirds (61%) were aware of the tiered-rebate structure.

Eight of the eleven store managers reported noticing an effect of the tiered rebate levels for clothes washers (Table 3-5). Of those eight respondents, five mentioned that the higher tier for more efficient washers made it easier to upsell customers who were already sold on an ENERGY STAR unit to an even more efficient machine. However, two managers complained that it was difficult to determine which models belonged in which tier. One respondent indicated that all the washers his store sold qualified for the $100 rebate tier, but according to program records, that was not the case. The confusion about which models qualified for which tier was corroborated by several other store managers in response to other interview questions.

Table 3-5: Store Manager Estimated Impact of Tiered Rebate on Clothes Washer Sales

Question	Count of Respondents
Noticed an effect of the tiered rebate levels for clothes washers[i]	8
Mentioned that the higher tier helps with the upsell	*5*
Mentioned that the tiers were difficult to understand	*2*
Mentioned that tiers led to customers getting a nicer machine for the same price	*1*
Mentioned that people care about efficiency and the tier sweetened the deal	*1*
Recommends offering tiered rebate levels on other appliances	4
Dishwashers	*2*
Refrigerators and freezers, based on size	*1*

[i] Multiple response

Four of the eleven store managers recommend offering tiered rebate levels on other appliances. Two managers mentioned dishwashers, both pointing out that most dishwashers are already ENERGY STAR, though some are more efficient than others. One respondent mentioned that the rebate for refrigerators and freezers was often disproportionately high or low given the size of the unit, and that he recommends structuring those rebates based on size instead.

3.3 Program Satisfaction

In this section, we present findings regarding the level of program satisfaction from store managers and participants.

3.3.1 Retailer Perspectives

The majority of interviewed store managers (10 of 11) reported being somewhat or very satisfied with the overall program. Just one respondent was unsatisfied.

However, store managers commonly indicated that they would prefer if the program were consistently offered (8 of 11). A few respondents even mentioned that rebates for point-of-sale items like room air conditioners should be eliminated in order to prolong the life of the rebate funds. Other suggestions for improvement included that the program require the serial number of an appliance, rather than just the model number, in the interest of reducing fraud (two respondents), that the program institute an online rebate process (one respondent), and that the program introduce a "buy more, save more" rebate structure where a customer purchasing both a clothes washer and a refrigerator, for instance, would receive a larger rebate than the sum of the individual clothes washer and refrigerator rebates (one respondent).

Eight of the eleven store managers reported that program field staff provided their sales staff with training, and all eight were very satisfied with it (Table 3-6). The remaining three indicated that there had not been any training; one of these three mentioned that field staff would answer questions if needed, and the other two reported that they found the program to be self-explanatory. One of the respondents in the group that received training said, "There are no obstacles [to selling ENERGY STAR appliances] if you know your product. What [the program] need[s] to emphasize is [for sales staff] to know the product."

Table 3-6: Store Manager Satisfaction with Program Components

Level of Satisfaction	Overall Program	Training	Point-of-Purchase Materials	Eligible Appliances
Very satisfied	6	8	4	8
Somewhat satisfied	4	0	5	3
Somewhat unsatisfied	1	0	1	0
Not at all satisfied	0	0	1	0
Not Applicable	0	3	0	0

All eleven store managers reported being familiar with the program's point-of-purchase materials, and nine reported being somewhat or very satisfied with them. The most commonly-cited suggestion for improving the materials was to rethink the stickers; three respondents mentioned that they leave residue and one said they would not stick. Magnets were suggested by one respondent as an alternative. Other suggestions made were to transition to an instant rebate

(one respondent), to consolidate all the rebate forms into one form (one respondent), and to eliminate the tri-fold forms in favor of a standard piece of paper (one respondent).

Store managers were asked for their level of satisfaction with the appliances types that were eligible for rebates. The majority (8 of 11) indicated that they were very satisfied, while the remaining three reported being somewhat satisfied. When asked to suggest additional appliances to include in the future, most respondents (7 of 11) mentioned dishwashers, though some acknowledged that because most dishwashers are already ENERGY STAR, they understand why dishwashers were not included. Other appliances mentioned were dryers (2 of 11), ranges, sink disposals, solar hot water, and wall-mounted unit heaters (one respondent each).

Most store managers (9 of 11) were satisfied with the rebate amounts (Table 3-7). Respondents indicated that rebate amounts were too high in three instances; one respondent mentioned that the heat pump water heater rebate was too high at first, one mentioned that the heat pump water heater rebate remains too high, and one mentioned that the freezer rebate is too high relative to the price of freezers. In two instances, respondents indicated that rebate amounts were too low; both of these respondents mentioned that the high price of refrigerators relative to the rebate amount makes the rebate less effective on higher-end models, which tend to be high-efficiency.

Table 3-7: Store Manager Perspective on Rebate Amounts

Rating of rebate amounts[i]	Count of Respondents
Too high	3
Somewhat high	1
Just right	9
Too low	2
Comments	
Too low: range of refrigerator prices makes rebate less effective on higher-end models, which tend to be efficient	2
Too high: rebate can sometimes take 25% off the price of a smaller freezer	1
Heat pump water heater rebate was too high initially	1
Heat pump water heater rebate is too high	1

[i] Multiple response

3.3.1.1 Customer Feedback

Store managers were asked about the customer feedback they received before the rebates were discontinued at the end of August 2013 for most appliances (all except HPWH). Ten of the eleven store managers reported that they had received positive feedback. Specifically, they mentioned that customers "love it," that they "come in looking for the rebate," that "it was pretty easy for them," and that "several told their friends and family." However, one respondent mentioned that customers "don't appreciate that they have to send [the rebate form] out of state."

Since the rebates were discontinued for most appliances, customer feedback has mainly taken the form of disappointment that the program has ended (4 of 11 respondents) or lack of awareness that it had ended (4 of 11).

Store managers were also asked whether they had ever encountered a customer who purchased a program-eligible appliance, but who was not interested in receiving a rebate. Two of the eleven respondents indicated they had experienced this situation. One reported that a small number of customers had been hesitant because they believed they would receive junk mail as a result, and the other reported that one customer did not care enough to take the time to fill out the paperwork. In both cases, respondents indicated this was a rare occurrence. The remaining nine

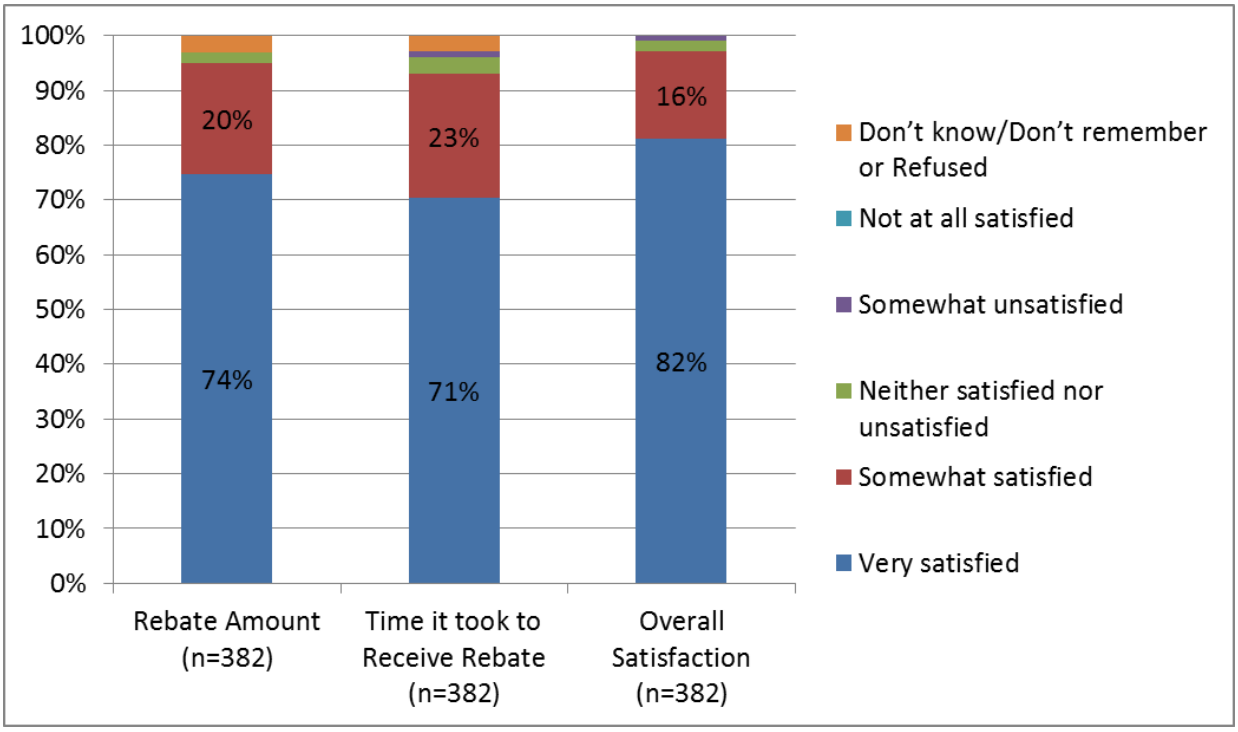
store managers indicated that all customers who bought a program-eligible appliance were interested in the rebate.

3.3.2 Customer Perspectives

All 382 program participants who responded to the telephone survey answered a series of questions geared at ascertaining their level of satisfaction with the program (Figure 3-4). Seventy-four percent of respondents reported being "very satisfied" with the rebate amount, ranging from 65% of refrigerator purchasers to 87% of those purchasing room ACs, freezers, and room air purifiers. Using the same five-point scale, 71% of participants were very satisfied with the time it took to receive the rebate. In addition, most participants (82% overall) were very satisfied with the overall rebate program.

Participants were also asked to rate the ease in completing and submitting the rebate application using a scale of one to five. Overall, most participants (75%) found the process to be "very easy".

Figure 3-4: Participant Satisfaction with Program Components

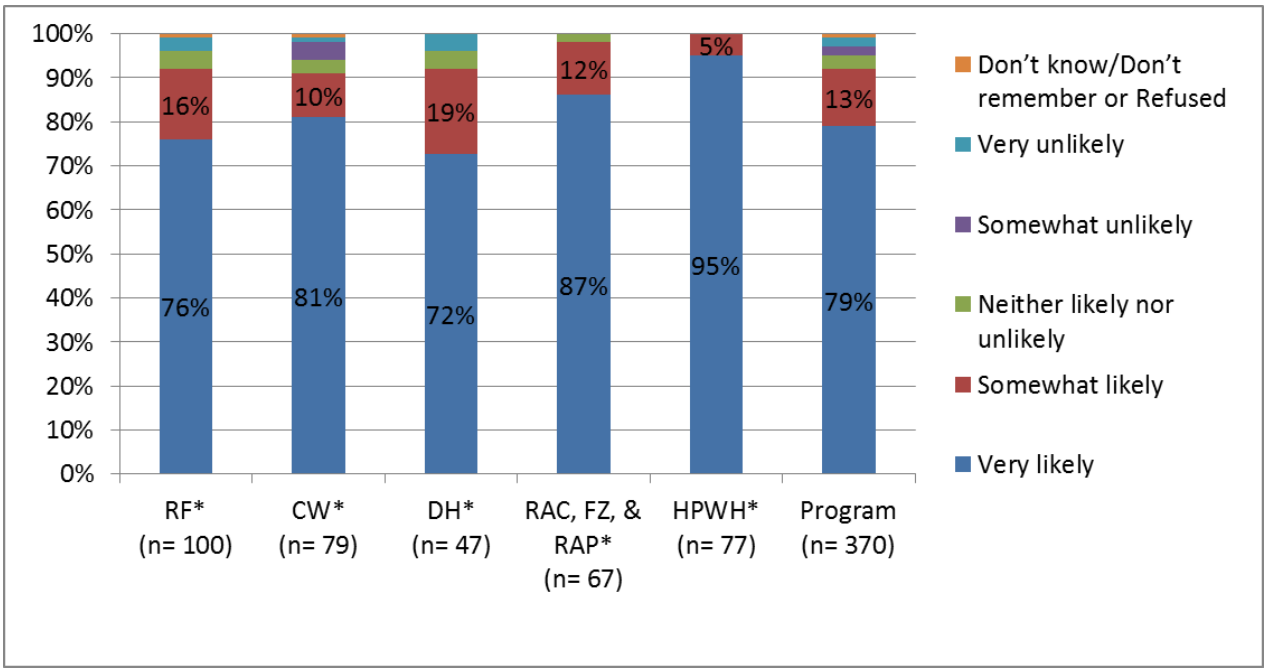


The few participants who reported being dissatisfied with the program were asked to elaborate. Of these seven respondents, two thought the rebate amount was too low, two reported that the rebate amount had increased after they had purchased their appliance (both of which were heat

pump water heaters), one said it had taken too long to receive the check, one had never received the check and one was disappointed with the limit of one rebate per household[65].

The participants who reported being satisfied with the program were asked how likely they were to recommend the program to others. Most of these respondents (79%) were very likely to recommend the program; notably, all satisfied heat pump water heater purchasers were somewhat or very likely to recommend the program (Figure 3-5).

Figure 3-5: Participant Likelihood of Recommending Program by Appliance Type



*RF=Refrigerator; CW=Clothes washer; DH=Dehumidifier; RAC, FZ, & RAP = Room air conditioner, Freezer, and Room air purifier; HPWH = Heat pump water heater

3.4 Decision Making

In this section we describe the decision making process of customers, as reported by store managers and program participants.

3.4.1 Store Manager Perspectives

Seven of the eleven store managers indicated that their customers exhibit a high level of demand for ENERGY STAR appliances regardless of whether or not a rebate is offered. No respondents indicated that customers exhibit low demand for these appliances. Two store managers noted that the ENERGY STAR label is more important to customers on refrigerators because they operate continuously, unlike a clothes washer. Five additional respondents volunteered that their customers come in specifically requesting ENERGY STAR rated appliances or are cognizant of

[65] In FY2013, the program limited each residence to one rebate for each appliance type per calendar year.

the importance of energy efficiency. One said, "A good percentage of them do their homework prior to coming in... seems like people are more conscious of ENERGY STAR." Another pointed out, "Everyone comes in wanting ENERGY STAR. Nobody really knows what it is, but they want it."

Asked about their customers' motivations for purchasing ENERGY STAR appliances, all eleven store managers mentioned saving money, and nine specifically mentioned saving money on utility bills. When pressed for other reasons, three mentioned being "green" or environmentally conscious, but most store managers identified saving money as the sole reason for purchasing these appliances.

Similarly, seven store managers identified up-front cost as the sole barrier to purchasing ENERGY STAR appliances (Table 3-8). Three of the eleven store managers mentioned a lack of technological understanding among customers, particularly regarding clothes washers. As one respondent said, "They want to open up a washing machine and see that it's full of water. A lot of them think that the clothes aren't getting clean because there isn't a lot of water in it."

Table 3-8: Store Manager Estimated Existing Demand for ENERGY STAR™ Appliances

Level of Demand	Count of Respondents
High	7
Medium-to-high	2
Medium	2
Low	0
Motivations for Purchasing ENERGY STAR™ Appliances[i]	
Save money on utilities / short payback period	9
Be more "green" / environmentally conscious	3
Save money generally	2
Obstacles to Selling ENERGY STAR™ Appliances[i]	
Up-front cost only	7
Technological understanding	3
No obstacles	1

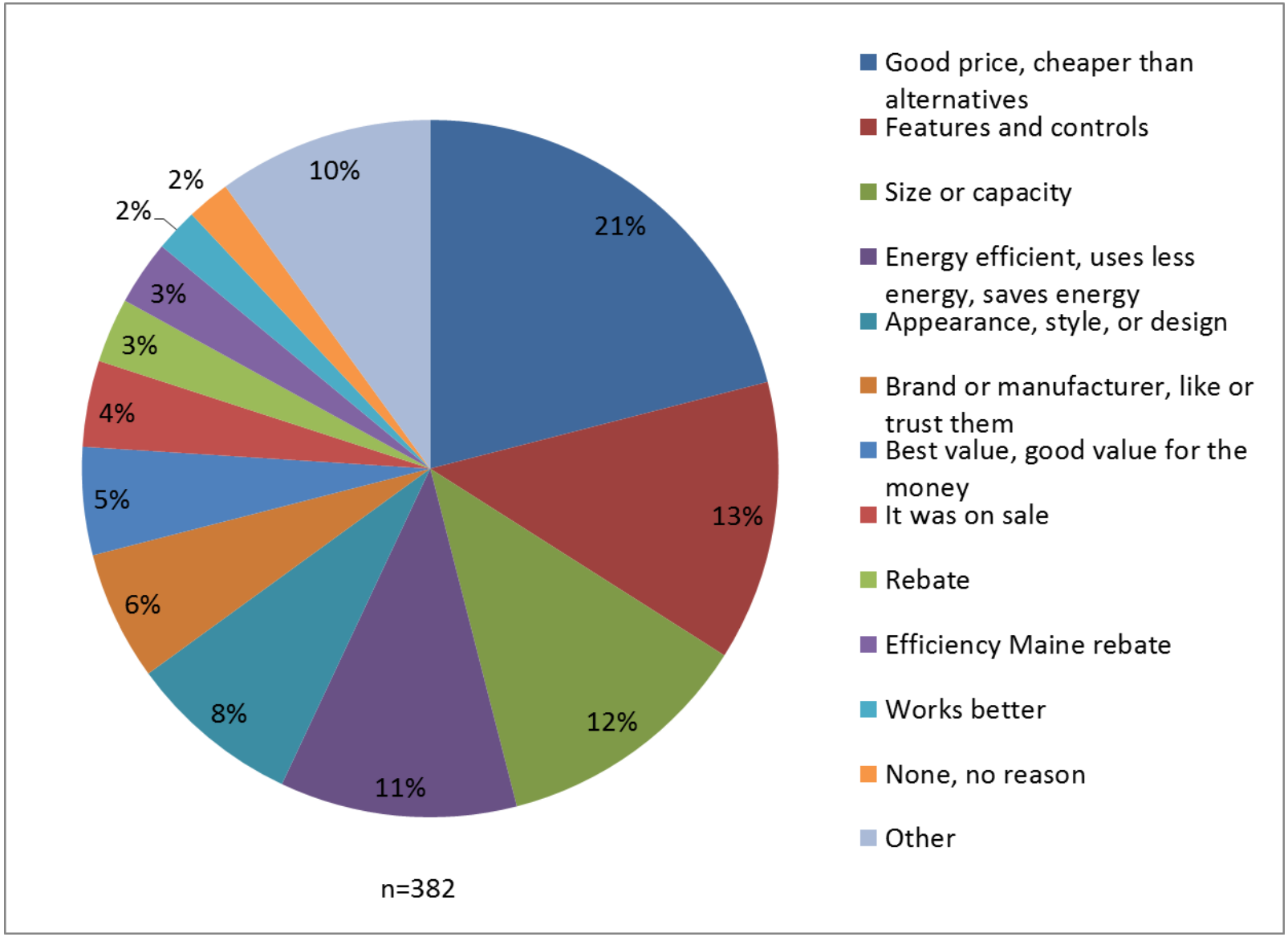
[i] Multiple response

3.4.2 Participant Perspectives

Program participants answered a series of questions about their decision to purchase the specific model of appliance for which they received a rebate. As illustrated in Figure 3-6, the reason most often cited by participants for purchasing their particular appliance is the good price, or the fact that it was cheaper than alternatives (21%). Other popular reasons included the size or capacity of the appliance (12%), the features and controls (13%), and its energy efficiency or savings (11%). Notably, 3% of respondents mentioned the Efficiency Maine rebate.

Heat pump water heater purchasers were somewhat more likely than other participants to indicate that the new appliance was energy efficient, uses less energy, or saves energy (25%).

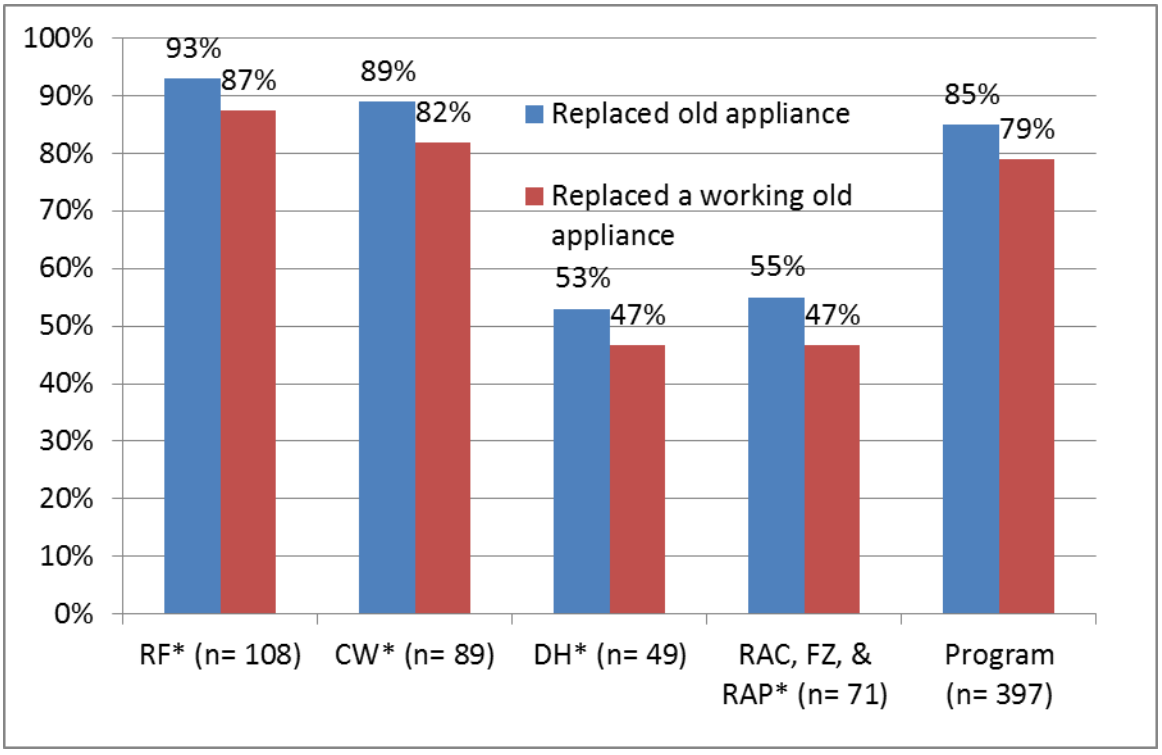
Figure 3-6: Participant Reported Most Important Reason for Purchasing Appliance Model



All participants reported whether they had replaced an old appliance with the new appliance purchased through the program or if they had not had an appliance of that type beforehand. Across the entire sample, the majority (85%) of all newly purchased appliances replaced an old appliance (Figure 3-7). However, responses varied across appliance types, with the majority of refrigerators (93%) and clothes washers (89%) replacing old appliances, given that nearly all homes already have these appliances. The numbers for dehumidifiers (53%) and room ACs, freezers, and room air purifiers (55%) were lower, with just over one-half replacing old appliances.

Participants who had replaced an old appliance were also asked whether their old appliance had been working at the time it was replaced. Nearly all of these respondents indicated that their old appliance had indeed been working when they purchased a replacement appliance through the program.

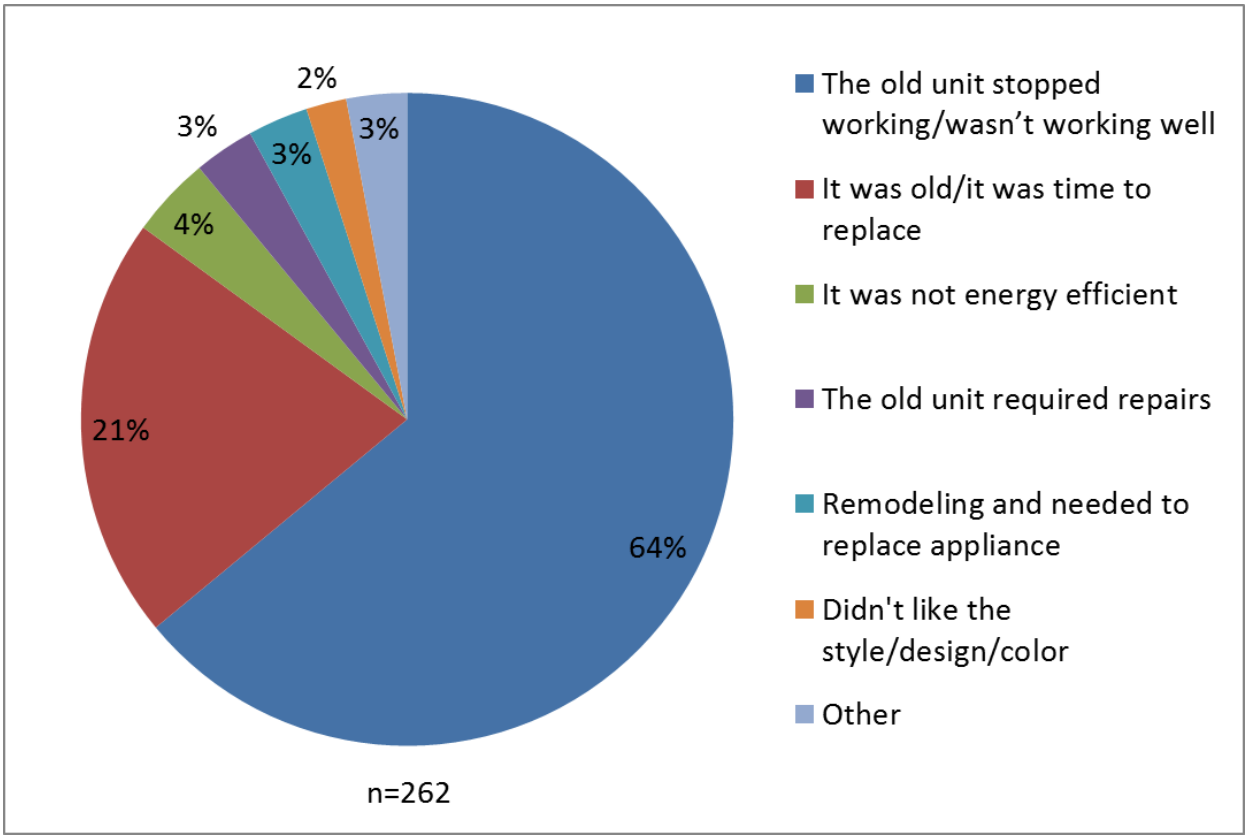
Figure 3-7: Participant Replacement of Old Appliances



*RF=Refrigerator; CW=Clothes washer; DH=Dehumidifier; RAC, FZ, & RAP = Room Air conditioner, Freezer, and Room air purifier

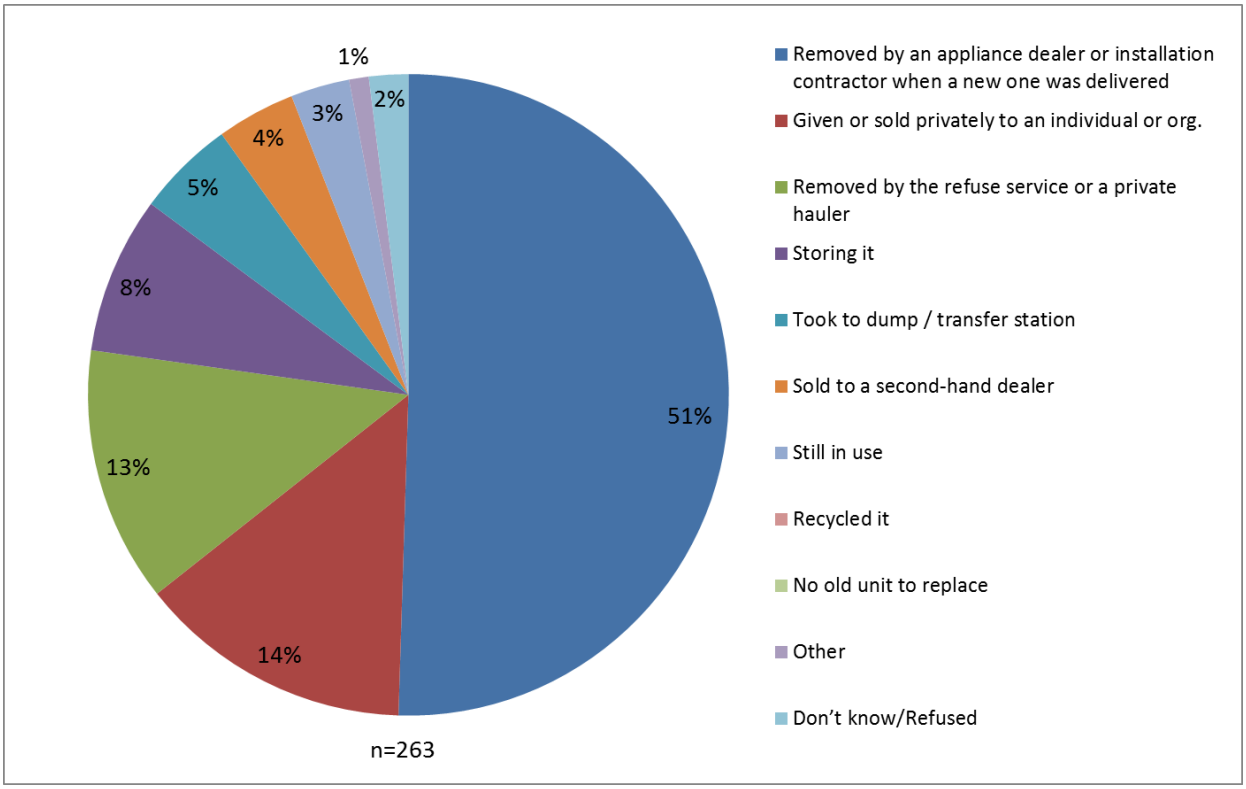
The 262 participants who had replaced an old appliance with a new one purchased through the program also indicated why they had chosen to replace their existing appliance (Figure 3-8). The two most common reasons were that the existing unit had stopped working or was not working well (64%) followed by it was old or time to replace it (21%). However, the most common reason for those who had purchased a heat pump water heater was that their old appliance was not energy efficient (29%); they also noted more often that their old appliance cost too much to operate (10%) or that a home energy audit had led them to their choice (10%).

Figure 3-8: Participant Reasons for Replacing Appliance



This same group of 262 respondents revealed what they had done with their old appliance (Figure 3-9). About one-half of appliances were removed by an appliance dealer or installation contractor when the new one was delivered (51%), primarily refrigerators and clothes washers. Old dehumidifiers were most often removed by the refuse service or a private hauler (31%), given/sold privately (19%), or stored (19%). Similarly, old room ACs, freezers and room air purifiers were being stored (26%) or were given or sold privately (23%).

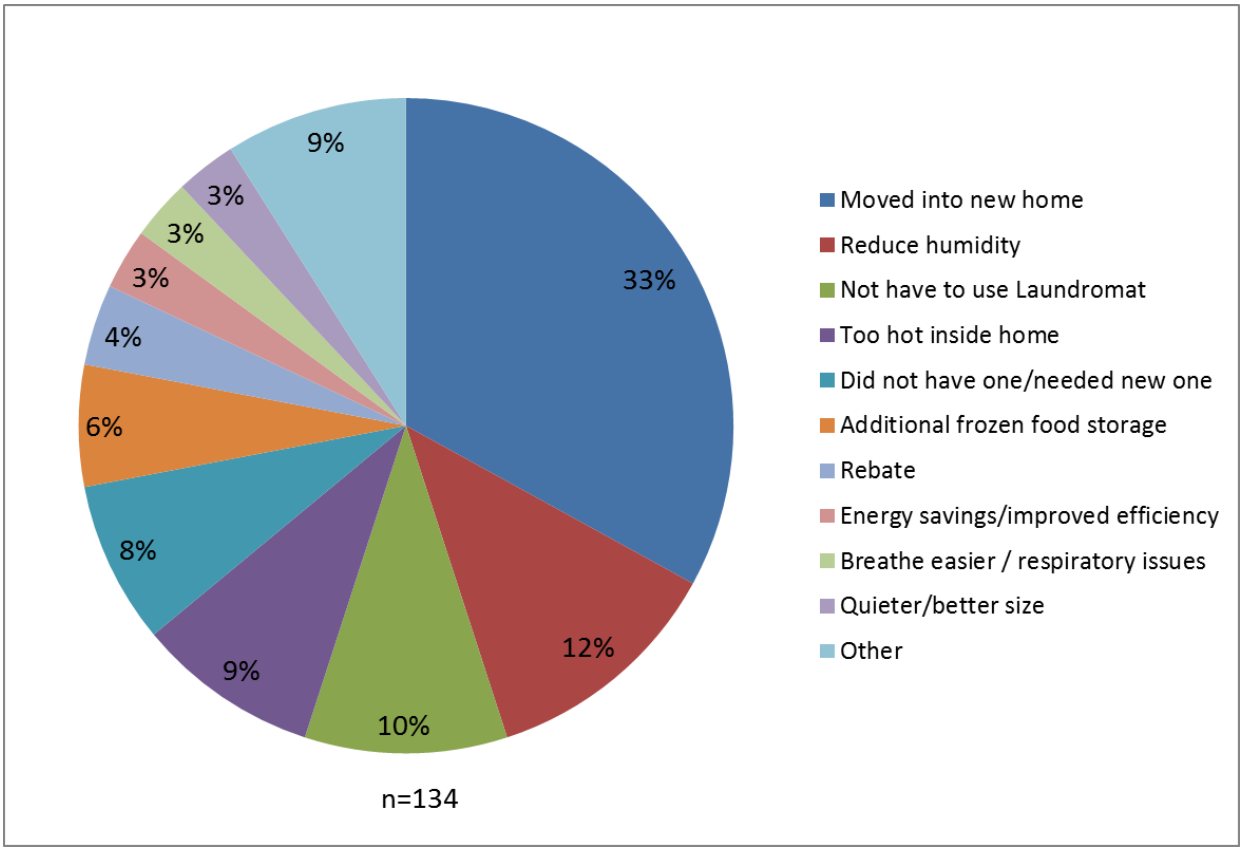
Figure 3-9: Participant Reported Disposition of Old Appliance



The 134 participants who did not have the appliance before purchasing one through the program also revealed their reasons for purchasing. As shown in Figure 3-10, the most common response was moving into a new home (33%). Otherwise reasons varied widely across appliance types, as indicated by the following common responses: reduce humidity (12%) which applies only to dehumidifiers, avoid the Laundromat (10%) which applies only to clothes washers, and too hot inside home (9%) which applies only to air conditioners. Notably, 4% of respondents mentioned a rebate.

Participants who purchased heat pump water heaters cited energy savings or improved efficiency (36%) and saving money (24%) as the reasons motivating the purchase. Additionally, 13% mentioned that the heat pump water heater was more cost effective or efficient than oil or that they did not want to use oil anymore.

Figure 3-10: Participant Reasons for Purchasing Non-Replacement Appliance



3.5 In-store Experience

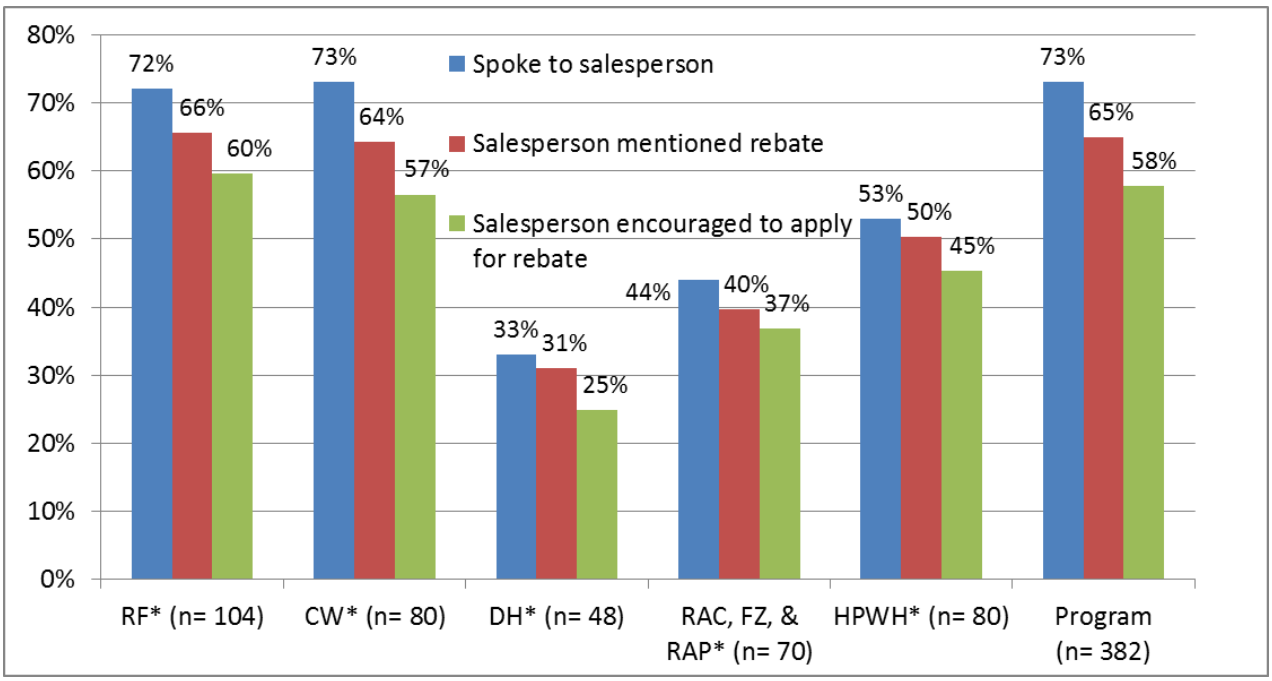
Nearly three-fourths of all participants (73%) said they had talked to a sales person about which appliance model to purchase. However, as shown in Figure 3-11, this proportion differed substantially across appliance types. Participants who purchased a refrigerator (72%) or clothes washer (73%) were most likely to have spoken with a sales person. However, only one-third of respondents who purchased a dehumidifier spoke with a sales person. While only 53% of heat

pump water heater respondents reported speaking with a sales person, it is likely that some participants may have instead interacted with their installation contractor.

Forty-four percent of respondents who purchased a room AC, freezer, and room air purifier had spoken with a sales person. However, this figure masks some underlying differences by appliance type as 33% of the 48 participants who purchased a room air conditioner spoke with a sales person compared to 15 of the 18 freezer respondents (83%).

Sales staff were also very likely to mention the Efficiency Maine rebate, as 65% of participants said that the sales person mentioned the Efficiency Maine rebate. Most of these participants (58% overall) reported that the sales person had also encouraged them to apply for the rebate.

Figure 3-11: Participant Reported Salesperson Interactions

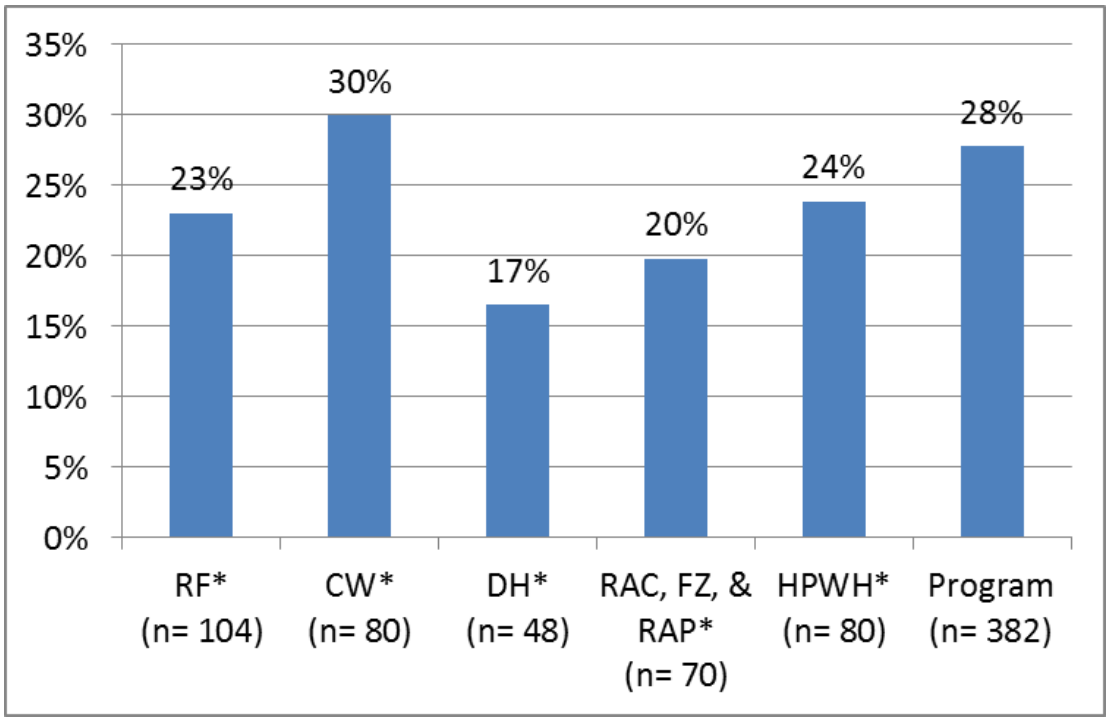


*RF=Refrigerator; CW=Clothes washer; DH=Dehumidifier; RAC, FZ, & RAP = Room air conditioner, Freezer, and Room air purifier; HPWH = Heat pump water heater

The store manager interviews corroborate these results as all eleven managers reported that their sales staff mention the rebates when discussing appliances with customers.

Twenty-eight percent of participants reported that the sales person had influenced their purchasing decision, although this figure varies by appliance type mostly depending on whether or not the customer spoke with a sales person (Figure 3-12).

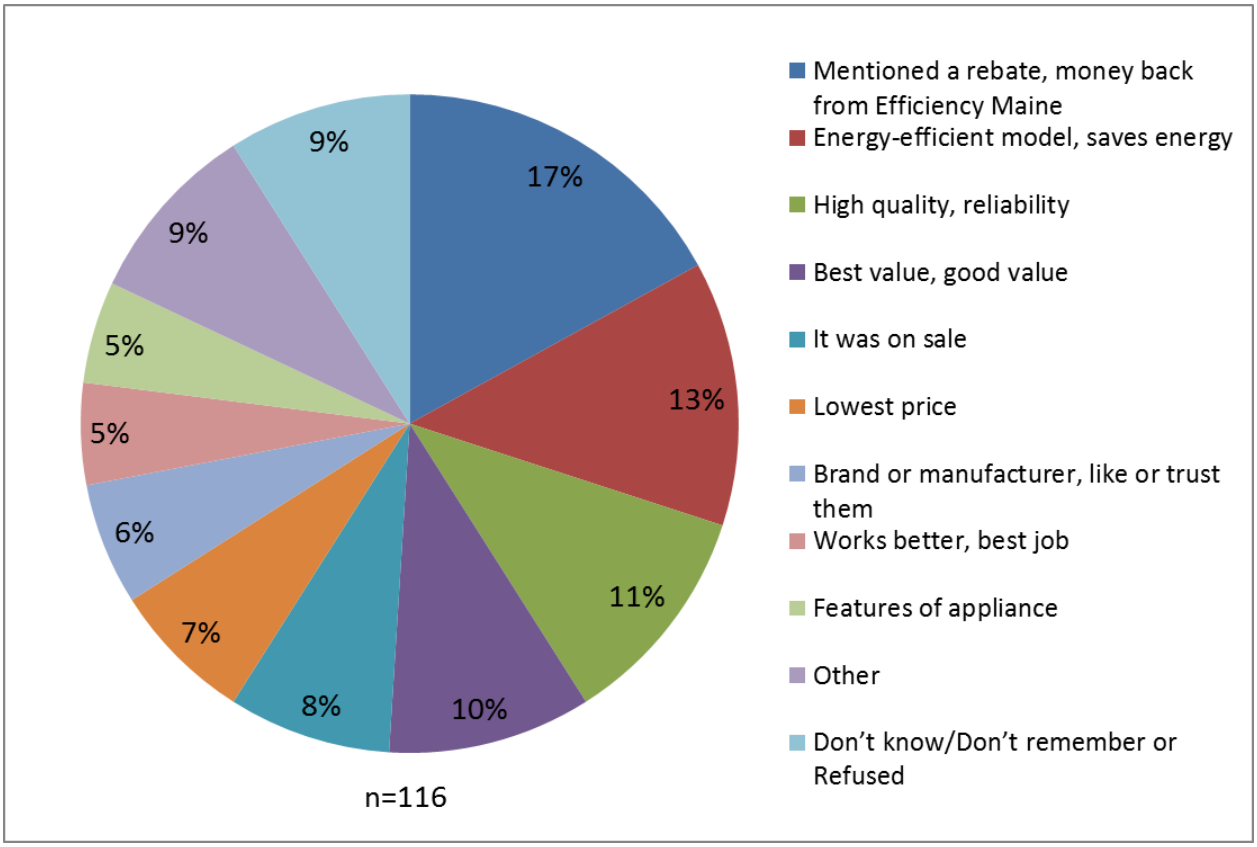
Figure 3-12: Participant Reported Salesperson Influence on Purchase



*RF=Refrigerator; CW=Clothes washer; DH=Dehumidifier; RAC, FZ, & RAP = Room air conditioner, Freezer, and Room air purifier; HPWH = Heat pump water heater

The 116 participants who indicated a sales person influenced their appliance purchase further explained how it occurred. The most popular response was that the sales person had mentioned a rebate or money back from Efficiency Maine (17%). Other influential factors included that the appliance was an energy efficient model or it saves energy (13%), that the model was of a high quality and was reliable (11%), and that it was the best value or a good value for the money (10%).

Figure 3-13: Participant Reported Influence of Salesperson on Purchase



3.5.1 Participation in Other Efficiency Maine Programs

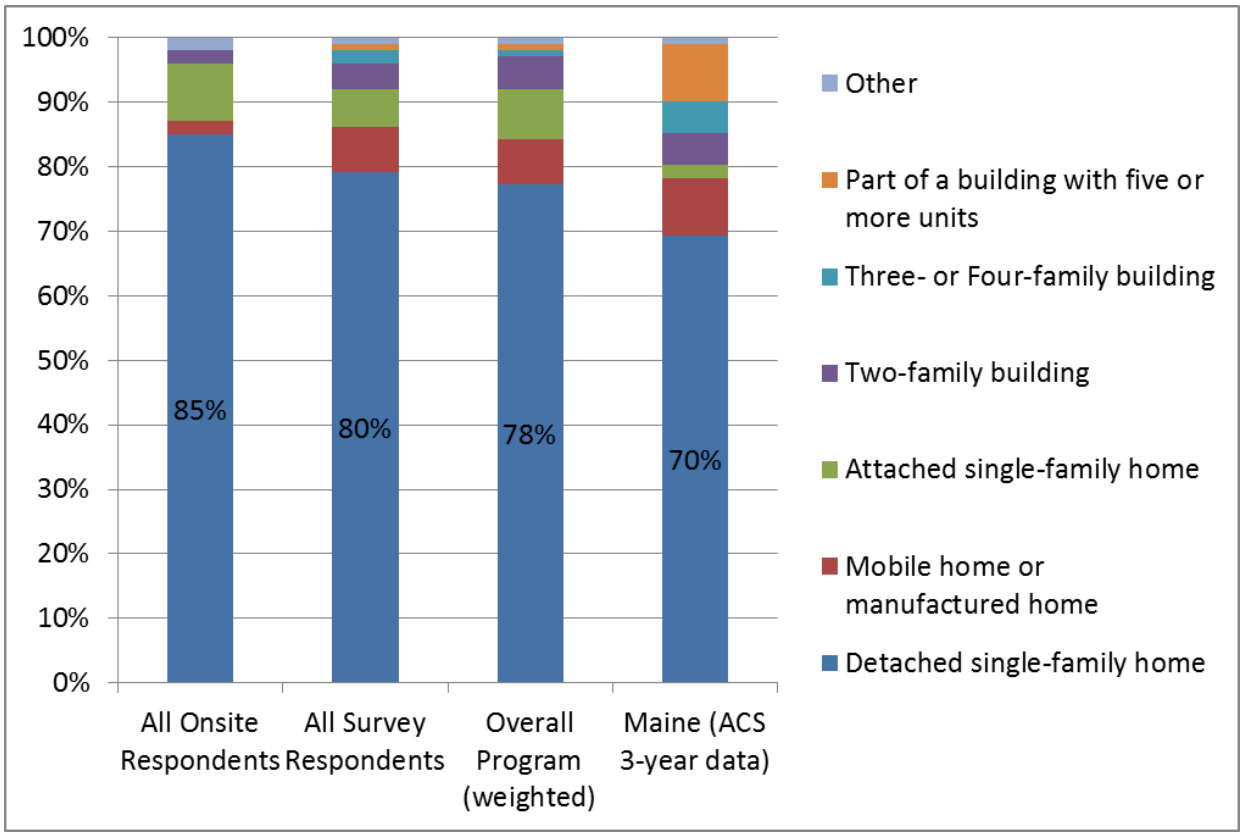
Eighteen percent of all participants reported participating in another Efficiency Maine program since purchasing their appliance through the Appliance Rebate program. Over one-third (34%) of the 72 participants who had participated in other Efficiency Maine programs reported having purchased a second appliance through the Appliance Rebate program. Seventeen percent had participated in the Residential Lighting Program for CFLs or LEDs, and another 16% had participated in the Home Energy Savings Program.

These 72 respondents rated the level of importance, using a scale from zero (not at all important) to ten (extremely important), that their participation in the Appliance Rebate program had on their decision to participate in the other programs. The majority of these 72 respondents (55%) said participation in the Appliance Rebate program had a high level of importance (7 – 10 rating) on their decision; the average rating was 6.0.

3.6 Participant Characteristics

Figure 3-14 displays the type of home for four categories of participants: the 70 onsite participants (unweighted), the 382 survey participants (unweighted), the 382 survey participants (weighted to reflect the overall program), and the U.S. Census American Community Survey[66] (ACS) 2009-2011 estimates for Maine. The types of homes represented by survey respondents are generally similar to those for all Maine residents; one notable difference, however, is that 14% of residents lived in a building with three or more units compared to just 2% of survey respondents.

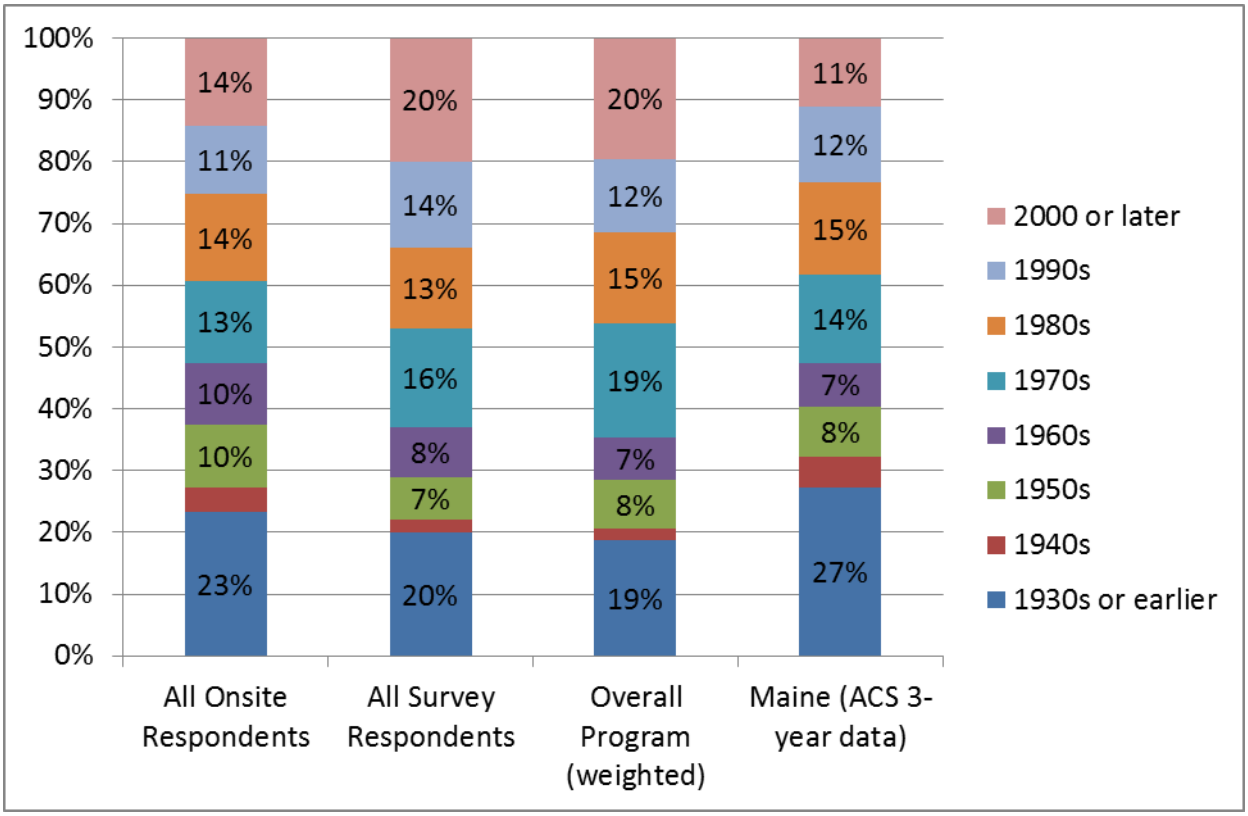
Figure 3-14: Participant Reported Type of Home



[66] http://www.census.gov/acs/www/

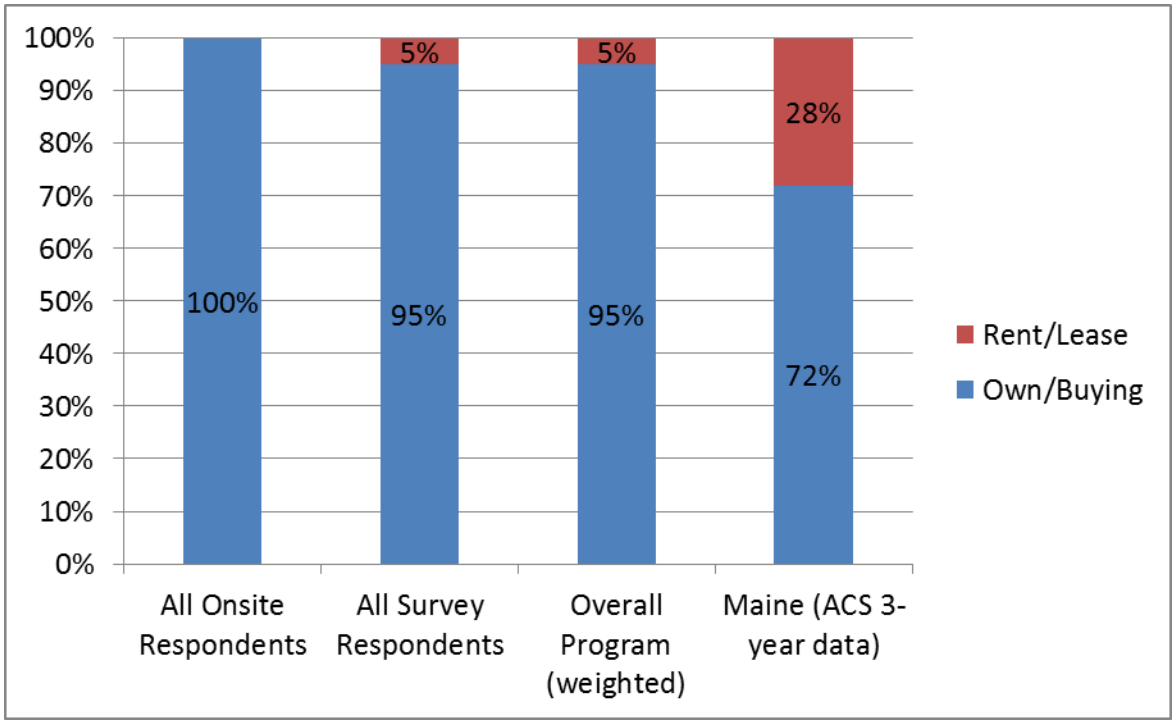
About one-fifth of participants' homes were built in the 1930s or earlier, while another one-fifth were built in the year 2000 or later. ACS data indicate that homes in Maine tend to be somewhat older, with 27% built in the 1930s or earlier (Figure 3-15).

Figure 3-15: Participant Reported Age of Home



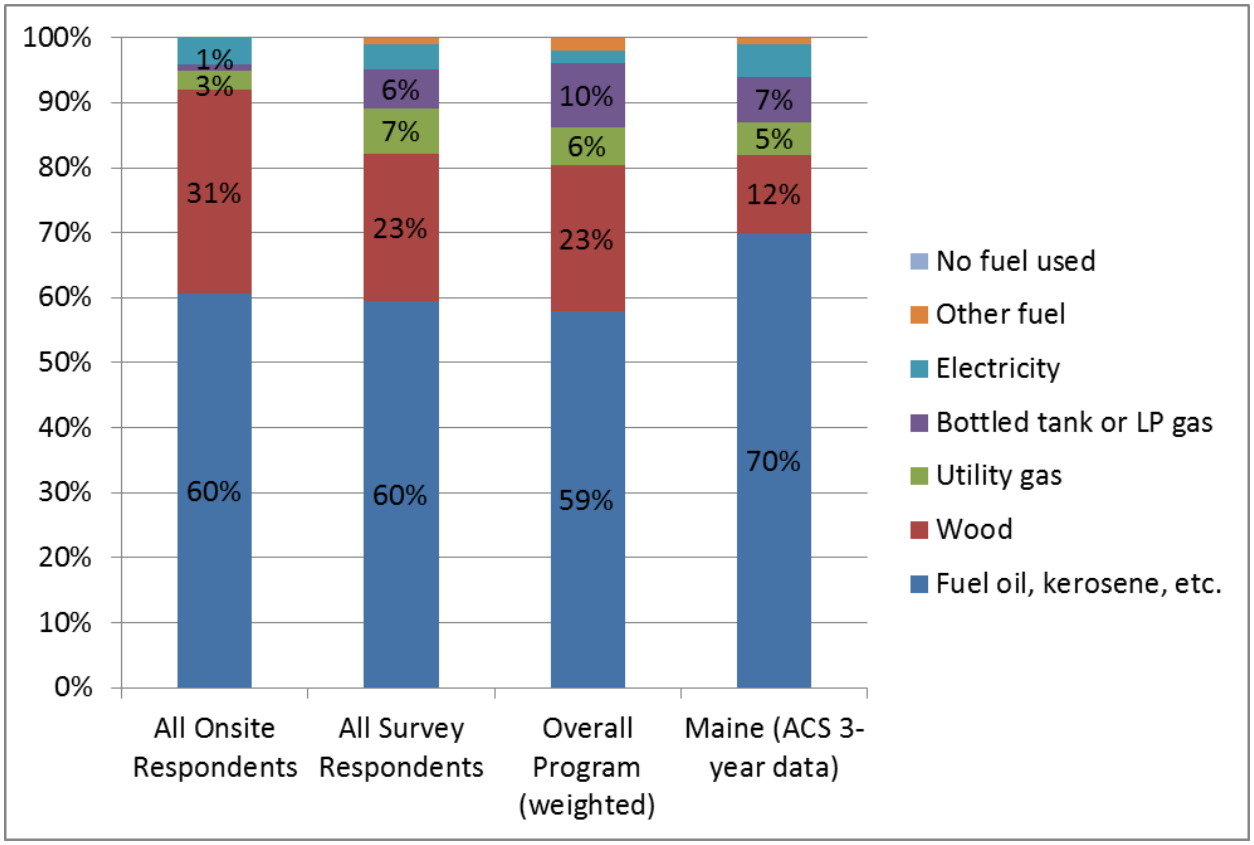
Nearly all participants owned or were buying their homes (95%+), which is higher than the statewide ACS figure of 72% (Figure 3-16).

Figure 3-16: Participant Tenure



The most common type of fuel used to heat the homes of participants was fuel oil and kerosene (about 60%) followed by wood (23%-31%). However, Maine residents are more likely to heat their homes with oil (70%) and less likely to heat with wood (12%).

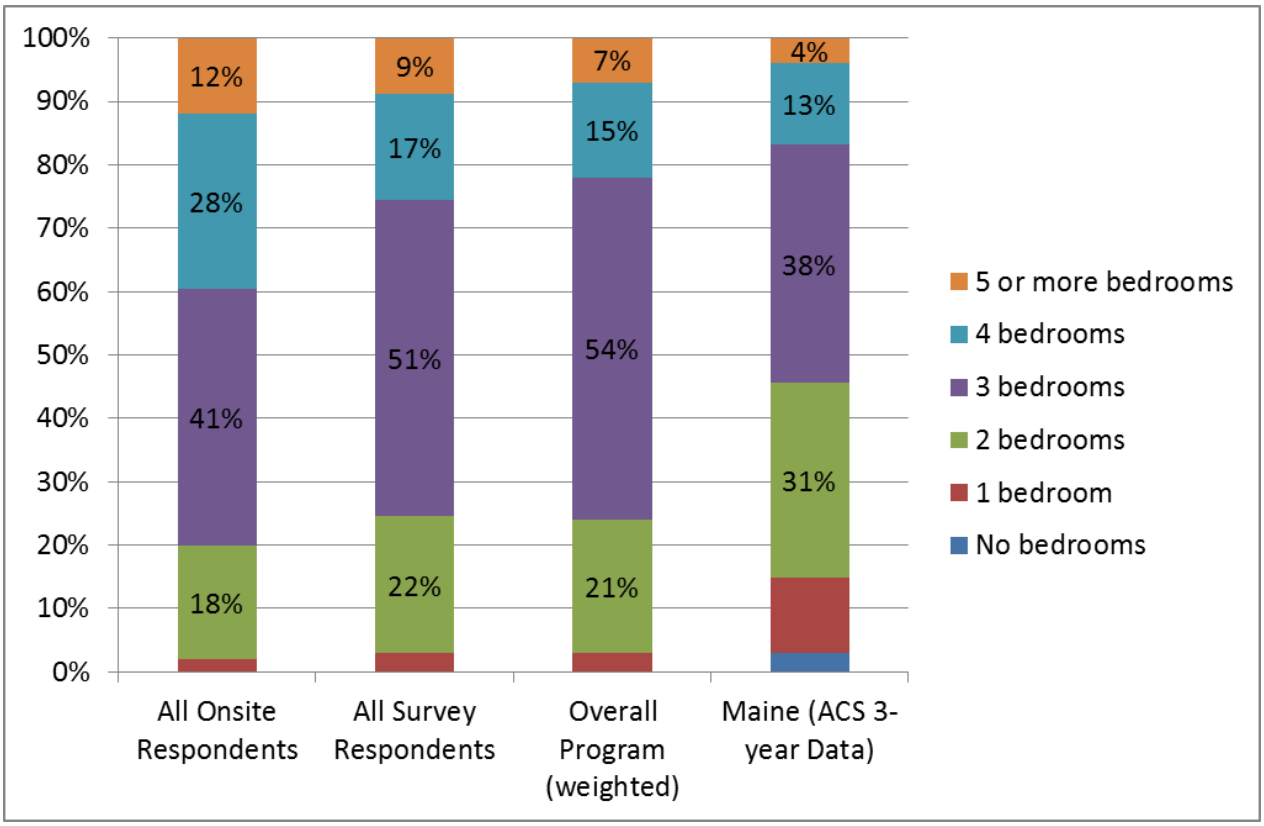
Figure 3-17: Participant Primary Heating Fuel



The average number of rooms (not including bathrooms, halls, garages, porches, and unfinished rooms) in participants' homes was 6.3, while the median, or the most common number of rooms, was 6 rooms. The median number of rooms from the ACS is 5.3, which suggests that respondent's homes are slightly larger than Maine homes.

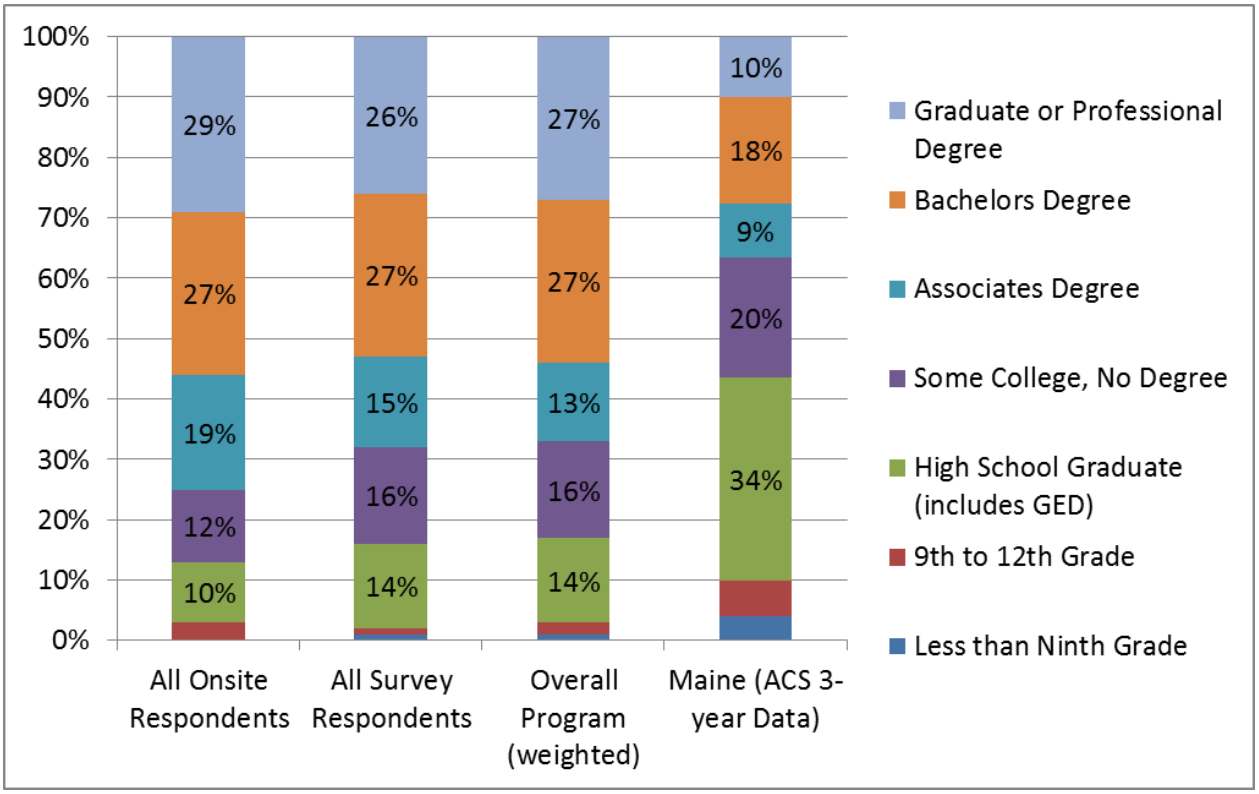
In addition, 22% to 40% of participants had 4+ bedroom homes, compared to 17% of all Maine residents; this provides further evidence that participant homes are larger than the average Maine home.

Figure 3-18: Participant Number of Bedrooms



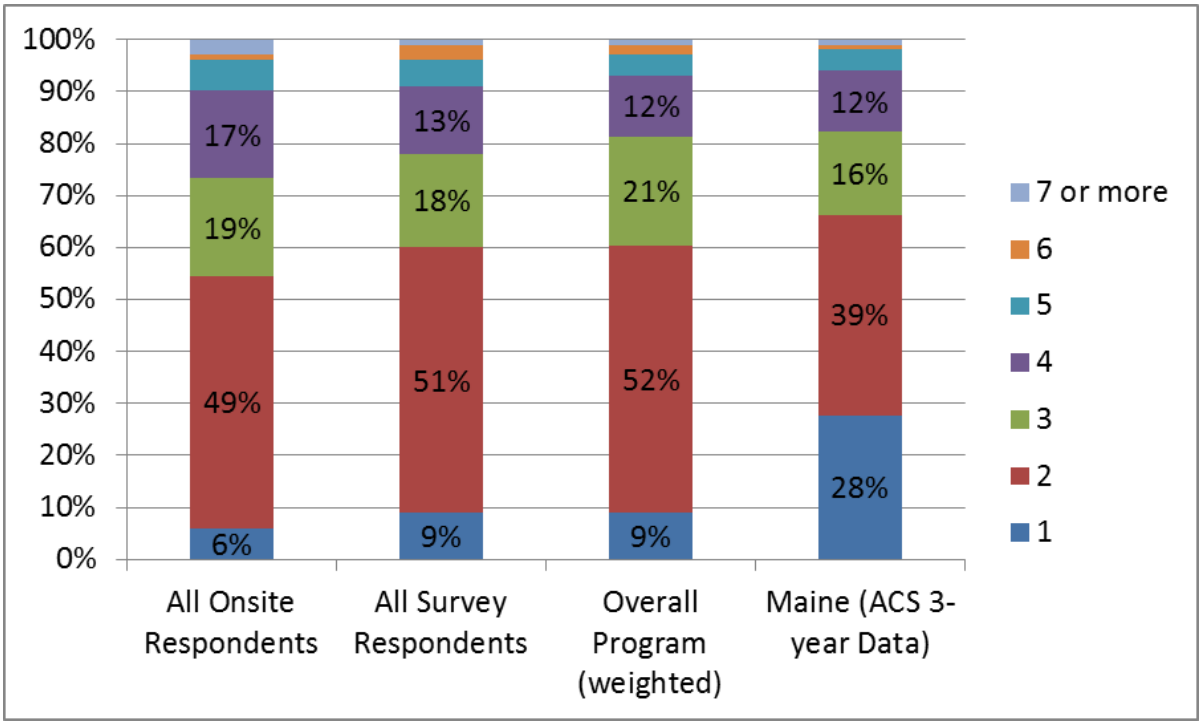
Over one-half of participants had a bachelor's degree or a graduate or professional degree, which is substantially higher than the statewide ACS estimate of 28% (Figure 3-19).

Figure 3-19: Participant Level of Education



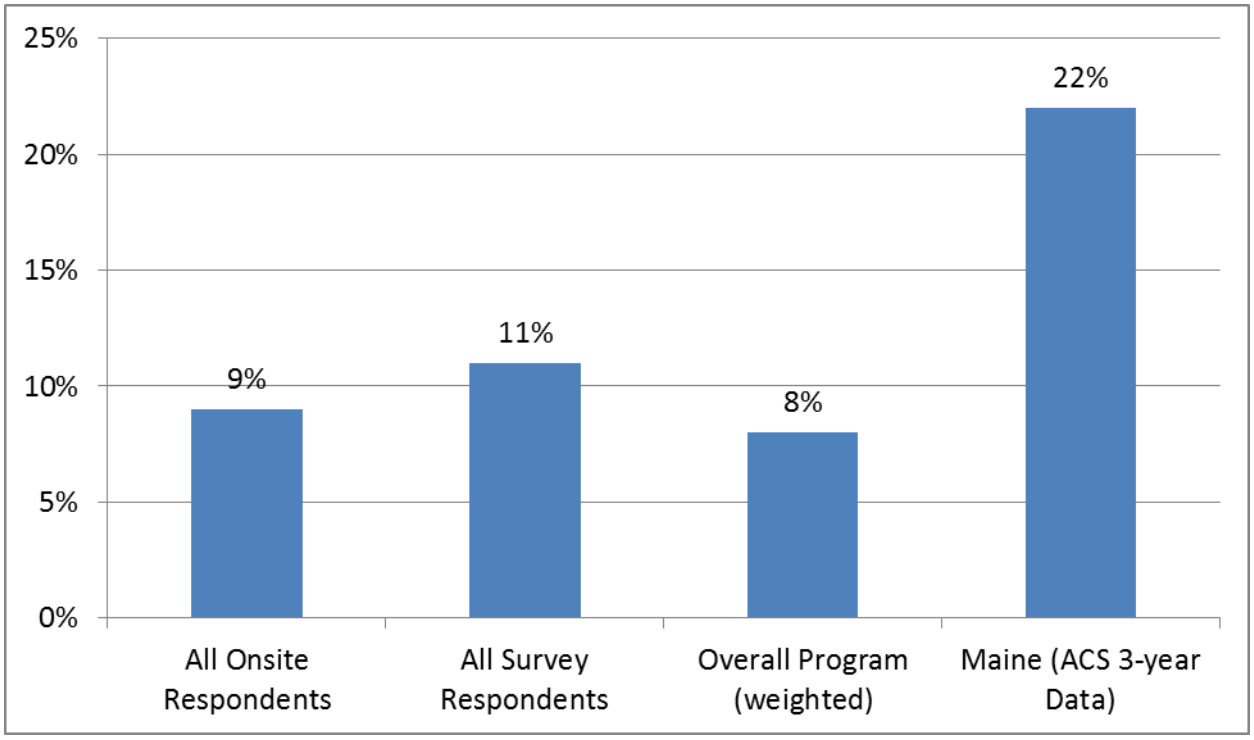
About one-half of all participants live in two-person households, with few living in single-person homes (6%-9%). Maine residents are more likely to have single-person households (28%) and less likely to have two-person households (39%), which indicates that participants have larger sized households (Figure 3-20).

Figure 3-20: Participant Household Size



Participants were asked a battery of questions to assess their income status. This battery included questions about their household income in relation to Maine Low Income Home Energy Assistance Program requirements[67]. Those survey respondents who refused to provide their income were asked about their receipt of federal or state benefits that would indicate low-income status. Between 8% and 11% of participants were found to be low-income, compared to 22% of all Maine residents (Figure 3-21). This indicates that participants earn higher incomes than typical Maine residents.

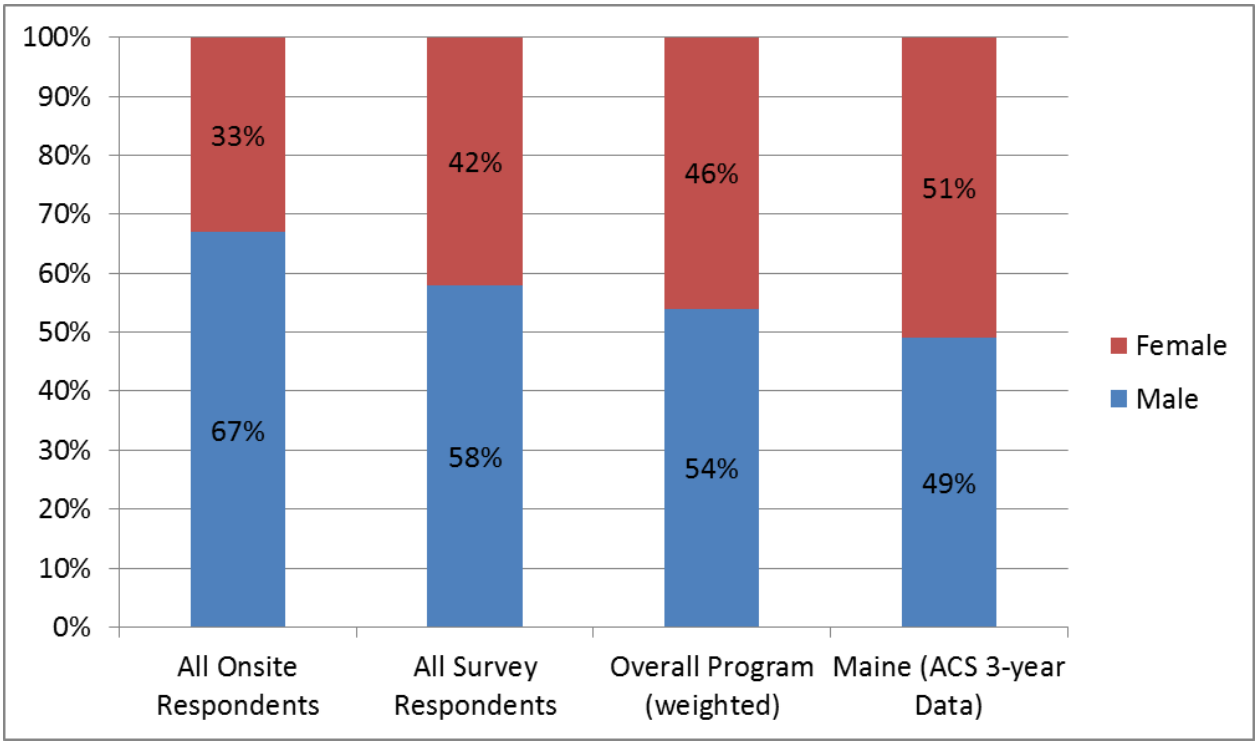
Figure 3-21: Participant Low Income Status



[67] http://www.benefits.gov/benefits/benefit-details/1558

Maine residents and all participants tend to be fairly equally split among genders (Figure 3-22). However, 67% of the onsite participants and 70% of heat pump water heater purchasers were male.

Figure 3-22: Participant Gender



Appendix A Additional Tables from Participant Telephone Survey

Tables

A.1 Program Awareness

Table A-1: Where Learned about Rebate – Multiple Response

(Base: All survey respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*108*	*89*	*49*	*71*	*80*	*397*	*397*
Sales staff at retail store/at store where purchased appliance	82%	87%	82%	81%	52%	77%	84%
TV/Radio/Newspaper ad/article/story	8%	2%	2%	1%	7%	5%	5%
Efficiency Maine website	2%	2%	2%	5%	14%	5%	2%
Word of mouth - friend, coworker, neighbor	3%	1%	2%	3%	15%	5%	2%
Rebate Application packet	1%	2%	4%	3%	0%	2%	2%
Online (not Efficiency Maine website)	0%	2%	0%	0%	4%	1%	1%
Information that came with my new appliance	1%	0%	4%	1%	0%	1%	1%
Information that came with my utility bill	1%	0%	0%	0%	0%	<1%	<1%
At an event	1%	0%	0%	0%	1%	<1%	<1%
Energy auditor	0%	0%	0%	0%	1%	<1%	<1%
Contractor	0%	0%	0%	1%	1%	<1%	<1%
Other	0%	0%	2%	1%	2%	1%	<1%
Don't Know/Refused	3%	3%	2%	3%	1%	2%	3%

Table A-2: Awareness of Rebates at Time of Purchase

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*108*	*89*	*49*	*71*	*80*	*397*	*397*
Yes	57%	60%	63%	49%	81%	62%	57%
No	38%	37%	33%	51%	18%	35%	39%
Don't know/Don't remember or Refused	5%	3%	4%	0%	1%	3%	4%

Table A-3: Whether Respondents Saw Signs for Rebate in Store

(Base: All survey respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*382*	*382*
Yes	65%	75%	58%	73%	63%	67%	70%
No	22%	13%	31%	20%	31%	23%	18%
Don't know/Don't remember or Refused	13%	13%	10%	7%	6%	10%	12%

A.2 Appliance Installation

Table A-4: Whether New Appliance is Installed and Operating

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*382*	*382*
Yes	97%	100%	94%	93%	96%	96%	98%
No	3%	0%	6%	7%	4%	4%	2%

Table A-5: When Appliance Expected to Be Installed

(Base: Respondents whose appliance was not currently installed and operating)

	Refrig-erators (count)	Clothes Washers (count)	De-humidifiers (count)	Room ACs, Freezers, & Room Air Purifiers (count)	Heat Pump Water Heaters (count)	All Survey Respondents (count)	Overall Program (weighted)
Number of Respondents	*3*	*0*	*3*	*5*	*3*	*14*	*8*
Sept-Dec 2013	2 (67%)	0	3 (100%)	0	3 (100%)	8 (57%)	4 (54%)
Jan-April 2014	0	0	0	2 (40%)	0	2 (14%)	1 (11%)
May-Aug 2014	0	0	0	3 (60%)	0	3 (21%)	1 (16%)
Don't know/Don't remember	1 (33%)	0	0	0	0	1 (7%)	2 (19%)

Table A-6: Location of Dehumidifier

(Base: Respondents who purchased a new dehumidifier)

Room	Dehumidifiers
Number of Appliances	*49*
Basement	84%
Living Room	6%
Family Room or Den	4%
Utility Room	2%
Garage	2%
Other	2%

A.3 Reasons for Purchase

Table A-7: Most Important Reason for Purchasing Appliance

(Base: All survey respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*382*	*382*
Good price, cheaper than alternatives	21%	20%	21%	23%	19%	21%	21%
Features and controls	12%	16%	6%	10%	4%	10%	13%
Size or capacity	21%	4%	13%	13%	0%	10%	12%
Energy efficient, uses less energy, saves energy	9%	13%	10%	7%	25%	13%	11%
Appearance, style, or design	12%	6%	6%	1%	0%	5%	8%
Brand or manufacturer, like or trust them	4%	8%	0%	6%	6%	5%	6%
Best value, good value for the money	3%	6%	2%	6%	4%	4%	5%
It was on sale	3%	6%	4%	3%	1%	3%	4%
Rebate	3%	3%	8%	7%	9%	5%	3%
Efficiency Maine rebate	2%	3%	0%	7%	1%	3%	3%
Works better	2%	3%	2%	1%	1%	2%	2%
None, no reason	3%	1%	0%	1%	0%	1%	2%
Availability at store/website	1%	0%	10%	3%	13%	5%	1%
High quality or reliability	0%	3%	2%	0%	4%	2%	1%
Recommendation from friends, family, or neighbor	1%	1%	2%	0%	4%	2%	1%

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Consumer Reports recommendation	0%	1%	6%	3%	4%	2%	1%
Recommendation from sales person, sales person said it was good	0%	3%	0%	1%	3%	1%	1%
ENERGY STAR label	1%	1%	2%	1%	1%	1%	1%
Recommendation from contractor	0%	1%	0%	0%	0%	<1%	1%
Lower utility bills, save money on operating cost	0%	1%	0%	0%	0%	<1%	1%
Liked it/needed one in general	0%	0%	2%	3%	0%	1%	<1%
Makes less noise, quieter	0%	0%	0%	0%	1%	<1%	<1%
Manufacturer rebates	0%	0%	0%	1%	0%	<1%	<1%
Other	2%	1%	2%	0%	0%	1%	1%
Don't know/Refused	2%	0%	0%	1%	1%	1%	1%

Table A-8: Additional Reasons for Purchasing Particular Appliance – Multiple Response

(Base: All survey respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*382*	*382*
Good price, cheaper than alternatives	19%	11%	12%	18%	11%	15%	15%
Size or capacity	14%	10%	12%	16%	3%	11%	12%
Energy efficient, uses less energy, saves energy	8%	13%	6%	8%	13%	10%	10%
Features and controls	8%	8%	8%	1%	2%	6%	7%
It was on sale	6%	5%	6%	11%	8%	7%	6%
Brand or manufacturer, like or trust them	3%	4%	2%	8%	4%	4%	4%
Appearance, style, or design	4%	4%	2%	4%	2%	3%	4%
Recommendation from sales person, sales person said it was good	3%	2%	2%	3%	8%	4%	3%
Efficiency Maine rebate	1%	5%	4%	0%	4%	3%	3%
Availability at store/website	3%	1%	0%	4%	3%	3%	2%
Consumer Reports recommendation	2%	2%	2%	5%	1%	2%	2%
Best value, good value for the money	1%	2%	4%	1%	3%	2%	2%
High quality or reliability	1%	2%	2%	4%	2%	2%	2%
Works better	3%	2%	2%	0%	4%	2%	2%
Recommendation from contractor or friend, family, or neighbor	0%	4%	0%	0%	7%	2%	2%
Lower utility bills, save money on operating cost	0%	2%	0%	0%	3%	1%	1%

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Makes less noise, quieter	1%	1%	0%	1%	2%	1%	1%
ENERGY STAR label	1%	0%	2%	0%	0%	<1%	<1%
Good for environment, less pollution	0%	0%	4%	0%	0%	<1%	<1%
Manufacturer rebates	0%	1%	0%	0%	0%	<1%	<1%
Liked it/needed one in general	0%	0%	2%	0%	0%	<1%	<1%
Warranty	1%	0%	0%	0%	1%	<1%	<1%
Other	2%	0%	0%	0%	1%	1%	1%
None, no reason	19%	17%	31%	14%	16%	19%	18%
Don't know/Refused	1%	1%	0%	3%	0%	1%	1%

A.4 Decision Making

Table A-9: Why Replaced Appliance – Multiple Response

(Base: Respondents who replaced old appliances)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*100*	*79*	*26*	*39*	*21*	*262*	*262*
The old unit stopped working/wasn't working well	55%	70%	74%	48%	19%	57%	64%
It was old/it was time to replace	28%	18%	7%	26%	14%	22%	21%
It was not energy efficient	5%	2%	0%	7%	29%	6%	4%
The old unit required repairs	4%	2%	4%	0%	5%	3%	3%
Remodeling and needed to replace appliance	5%	1%	4%	0%	5%	3%	3%
Didn't like the style/design/color	3%	0%	0%	7%	5%	2%	2%
It cost too much to operate	1%	0%	4%	0%	10%	1%	1%
Moved to a new home	0%	2%	0%	2%	0%	1%	1%
Wanted a different/better one	0%	2%	0%	5%	0%	1%	1%
We were selling home	1%	0%	0%	0%	0%	<1%	1%
Due to a home energy audit	0%	0%	0%	0%	10%	1%	<1%
Due to Efficiency Maine program	0%	0%	0%	2%	5%	1%	<1%
Did not want old unit to break	0%	0%	4%	0%	0%	<1%	<1%
Other	0%	0%	4%	2%	0%	1%	1%

Table A-10: What Happened to Old Appliance

(Base: Respondents who replaced old appliances)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters (count)	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*101*	*79*	*26*	*39*	*18*	*263*	*263*
Removed by an appliance dealer or installation contractor when a new one was delivered	53%	54%	0%	10%	4 (22%)	40%	51%
Given or sold privately to an individual or org.	16%	10%	19%	23%	3 (17%)	16%	14%
Removed by the refuse service or a private hauler	11%	15%	31%	8%	2 (11%)	14%	13%
Storing it	5%	9%	19%	26%	5 (28%)	12%	8%
Took to dump / transfer station	5%	4%	12%	18%	0%	7%	5%
Sold to a second-hand dealer	3%	5%	4%	0%	1 (6%)	3%	4%
Still in use	6%	0%	4%	5%	0%	3%	3%
Recycled it	0%	0%	4%	5%	1 (6%)	2%	<1%
No old unit to replace	0%	0%	0%	0%	1 (6%)	<1%	<1%
Other	0%	1%	4%	0%	1 (6%)	1%	1%
Don’t know/Refused	1%	1%	4%	5%	0%	2%	2%

Table A-11: Why Purchased New Appliance – Multiple Response

(Base: Respondents who did not have an appliance beforehand)

	Refrig-erators (count)	Clothes Washers (count)	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*7*	*10*	*23*	*32*	*62*	*134*	*134*
Moved into new home	6 (67%)	5 (45%)	9%	6%	1%	11%	33%
Reduce humidity	0%	0%	83%	6%	4%	16%	12%
Not have to use Laundromat	0%	3 (27%)	0%	0%	0%	2%	10%
Too hot inside home	0%	0%	0%	39%	0%	9%	9%
Did not have one/needed new one	0%	2 (18%)	4%	3%	3%	4%	8%
Additional frozen food storage	1 (11%)	0%	0%	18%	0%	5%	6%
Rebate	1 (11%)	0%	0%	3%	8%	5%	4%
Energy savings/improved efficiency	0%	0%	0%	0%	36%	18%	3%
Breathe easier / respiratory issues	0%	0%	4%	9%	1%	3%	3%
Quieter/better size	0%	1 (9%)	0%	3%	1%	2%	3%
To save money	0%	0%	0%	0%	24%	11%	2%
Additional refrigerated food storage	1 (11%)	0%	0%	0%	0%	1%	2%
More cost effective/efficient than oil/Did not want to use oil any more	0%	0%	0%	0%	13%	6%	1%
Other	0%	0%	0%	12%	8%	7%	3%

Table A-12: How Sales Person Influenced Appliance Purchase – Multiple Response

(Base: Respondents that said sales person influenced their appliance purchase)

	Refrig-erators	Clothes Washers	De-humidifiers (count)	Room ACs, Freezers, & Room Air Purifiers (Count)	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*31*	*34*	*8*	*17*	*26*	*116*	*116*
Mentioned a rebate, money back from Efficiency Maine	13%	18%	1 (13%)	5 (29%)	27%	20%	17%
Energy-efficient model, saves energy	16%	12%	2 (25%)	1 (6%)	19%	15%	13%
High quality, reliability	6%	15%	0	1 (6%)	8%	9%	11%
Best value, good value	6%	12%	1 (13%)	1 (6%)	12%	9%	10%
It was on sale	16%	3%	0	1 (6%)	4%	7%	8%
Lowest price	6%	6%	0	3 (18%)	4%	7%	7%
Brand or manufacturer, like or trust them	6%	6%	1 (13%)	0%	0%	4%	6%
Works better, best job	6%	3%	1 (13%)	2 (12%)	8%	7%	5%
Features of appliance	10%	3%	1 (13%)	0%	0%	4%	5%
Helpful/good advice	0%	3%	1 (13%)	1 (6%)	4%	3%	2%
Long lifetime, last longer	0%	3%	0	0%	4%	2%	2%
Appliance delivery	0%	3%	0	0%	4%	2%	2%
Lower utility bills, save money on operating costs	3%	0%	0	0%	8%	3%	1%
Other	0%	6%	0	0%	0%	2%	3%
Don’t know/Don’t remember or Refused	10%	9%	0	2 (12%)	0%	7%	9%

A.6 Freeridership

In order to assess free-ridership and spillover, participants responded to a series of questions about the actions they may have taken if the Efficiency Maine appliance rebate had not been available. As Table A-13 illustrates, 83% all survey respondents said they would still have purchased the same appliance model even if the Efficiency Maine rebate had not been available. However, less than one-half (46%) of the participants who purchased heat pump water heaters said they would have purchased the same model.

Table A-13: Whether Participant Would have Purchased same Model if Rebate Not Available

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*108*	*89*	*49*	*71*	*80*	*397*	*397*
Yes	88%	83%	82%	70%	46%	75%	83%
No	8%	12%	8%	21%	50%	20%	12%
Don't know/Don't remember or Refused	4%	4%	10%	8%	4%	6%	4%

Respondents who said they would have purchased the same appliance without the rebate were also asked when they would have purchased the appliance: at the same time or at a later date. Overall and across all appliance types, participants indicated they would have purchased the appliance at the same time, even if the Efficiency Maine rebate had not been available (91% overall). We again note a difference between heat pump water heaters and other appliance types, with only 59% indicating they would have purchased the appliance at the same time (Table A-14).

Table A-14: When Participant would have Purchased same Model if Rebate Not Available

(Base: Respondents who would have purchased the same appliance without rebate)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*95*	*74*	*40*	*50*	*37*	*296*	*330*
At the same time	93%	88%	100%	94%	59%	89%	91%
At a later date	7%	11%	0%	4%	41%	11%	8%
Don't know/Don't remember or Refused	0%	1%	0%	2%	0%	1%	1%

Respondents who said they would not have purchased the same appliance had the Efficiency Maine rebate not been available were asked if they would have purchased a different model or if they would not have purchased an appliance at all. The majority (76%) of these 78 participants (representing 79 appliances) said they would have purchased a different model, while a small percentage (12%) said they would not have purchased an appliance. When looking only at the 40 participants who purchased heat pump water heaters, nearly three-quarters (73%) would not have purchased a new heat pump water heater had the rebate not been available (Table A-15).

Table A-15: What Participant would have Purchased if Rebate Not Available

(Base: Respondents who would not have purchased the same appliance without rebate)

	Refrig-erators (count)	Clothes Washers (count)	De-humidifiers (count)	Room ACs, Freezers, & Room Air Purifiers (count)	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*9*	*11*	*4*	*15*	*40*	*79*	*79*
Different model	7 (78%)	9 (82%)	3 (75%)	11 (73%)	8 (20%)	48%	76%
Would not have purchased	1 (11%)	0	1 (25%)	4 (27%)	29 (73%)	44%	12%
Don’t know/Don’t remember or Refused	1 (11%)	2 (18%)	0	0	3 (8%)	6%	13%

Sixty percent of the 37 respondents (representing 38 appliances) who said they would have purchased a different model without the rebate indicated the model they would have purchased would have a lower level of energy efficiency compared to the one they purchased with the Efficiency Maine rebate (Table A-16).

Table A-16: Level of Energy Efficiency of Model Participant would have Purchased if Rebate Not Available

(Base: Respondents who would have purchased a different model without rebate)

Level of Efficiency	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*7*	*8*	*3*	*11*	*8*	*38*	*38*
Higher	0	1	0	1	1	8%	1%
Similar	2	1	1	2	0	16%	18%
Lower	2	7	2	5	6	58%	60%
Don’t know/Don’t remember or Refused	3	0	0	3	1	18%	21%

The 234 respondents (representing 246 appliances) who were aware of the ENERGY STAR rebate rated the level of importance, on a scale from zero (not at all important) to ten (extremely important), that the rebate amount had on their decision to purchase their particular model of ENERGY STAR appliance. Overall, the most popular response was highly important (7-10 rating), cited by 39% of the sample. However, roughly one-quarter of the overall sample (28%) gave low importance to the rebate. Purchasers of heat pump water heaters were most likely to rate the rebate as highly important (88%) (Table A-17).

Table A-17: Importance of Rebate on Purchase Decision

(Base: Respondents that were aware of ENERGY STAR rebate)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Appliances	*62*	*53*	*31*	*35*	*65*	*246*	*246*
Mean	4.7	5.5	4.4	6.1	8.6	6.0	5.1
Low Importance (0-3)	39%	19%	42%	23%	2%	23%	28%
Moderate Importance (4-6)	29%	36%	19%	23%	11%	24%	32%
High Importance (7-10)	32%	43%	39%	54%	88%	53%	39%
Don't know/Don't remember or Refused	0%	2%	0%	0%	0%	0%	1%

Table A-18: Free Ridership by Appliance Type

(Base: All survey respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)	Overall Program (weighted by both rebate/survey ratio & energy savings)
Number of Appliances	*103*	*86*	*47*	*71*	*79*	*386*	*386*	*386*
Free Ridership Rate	67.8%	56.7%	65.3%	57.6%	21.0%	53.6%	61.0%	55.1%

A.7 Spillover

Sixteen percent of all survey respondents reported purchasing other energy-efficient products that were not covered by an Efficiency Maine rebate or other Efficiency Maine program since purchasing their new appliance through the appliance rebate program (Table A-19).

Table A-19: Whether Respondent Purchased Energy-Efficient Products Not Covered by Efficiency Maine Rebate or Program

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*382*	*382*
Yes	14%	18%	10%	21%	23%	17%	16%
No	80%	81%	88%	77%	75%	80%	81%
Don't know/Don't remember or Refused	7%	1%	2%	1%	3%	3%	4%

The 62 respondents who had purchased energy-efficient products not covered by an Efficiency Maine rebate or program reported having purchased many different types of products (Table A-20). The most common products purchased were an energy efficient room air conditioner (18%), followed by a refrigerator (17%) and a dishwasher (14%).

Table A-20: Purchased Energy-Efficient Products Not Covered by Efficiency Maine Rebate or Program – Multiple Response

(Base: Respondents that purchased energy-efficient products not covered by Efficiency Maine Rebate or Program)

	Refrig-erators (count)	Clothes Washers (count)	De-humidifiers (count)	Room ACs, Freezers, & Room Air Purifiers (count)	Heat Pump Water Heaters (count)	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*14*	*14*	*5*	*15*	*18*	*66*	*66*
Room air conditioner	4	2	1	3	1	15%	18%
Refrigerator	1	4	2	1	2	13%	17%
Dishwasher	3	2	0	1	0	8%	14%
Clothes Washer	3	0	0	3	2	11%	9%
Stove/Pellet Stove	2	1	0	0	2	27%	8%
Lightbulbs (CFL, LED, other efficient lighting)	1	0	1	3	1	8%	5%
Dehumidifier	1	1	0	0	0	3%	5%
Microwave	0	1	1	0	0	3%	4%
Furnace	1	0	1	0	1	14%	3%
TV	1	0	0	1	1	14%	3%
Freezer	0	1	0	0	0	1%	3%
Boiler	0	1	0	0	0	1%	3%
Heat Pump Water Heater	0	0	0	0	6	8%	1%
Windows	0	0	0	1	0	1%	1%
Doors	0	0	0	1	0	1%	1%
Laptop computer	0	0	0	1	0	1%	1%
Dryer	0	0	0	0	2	3%	<1%
Insulation	0	0	0	0	1	1%	<1%
Solar Panels	0	0	0	0	1	1%	<1%

Don't know/Don't remember or Refused	0	2	0	2	0	5%	8%

Of the 62 respondents who had purchased energy-efficient products not covered by an Efficiency Maine rebate or program, nearly three out of four (74%) reported that the product they purchased had an ENERGY STAR label (Table A-21).

Table A-21: Whether Purchased Energy-Efficient Products Not Covered by Efficiency Maine Rebate or Program have ENERGY STAR Label

(Base: Respondents that purchased energy-efficient products not covered by Efficiency Maine Rebate or Program)

	Refrig-erators (count)	Clothes Washers (count)	De-humidifiers (count)	Room ACs, Freezers, & Room Air Purifiers (count)	Heat Pump Water Heaters (count)	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*14*	*12*	*5*	*13*	*18*	*62*	*62*
Yes	12 (71%)	10 (77%)	2 (33%)	13 (87%)	11 (58%)	69%	74%
No	1 (6%)	2 (15%)	3 (50%)	1 (7%)	3 (16%)	14%	12%
Don't know/Don't remember or Refused	4 (24%)	1 (8%)	1 (17%)	1 (7%)	5 (17%)	17%	15%

As illustrated in Table A-22, roughly one-third (32%) of the 62 respondents who reported purchasing an ENERGY STAR labeled product not covered by Efficiency Maine rebates thought that participating in the appliance rebate program was highly important in that decision. However, 53% rate their program experience as having little importance on their purchase decision.

Table A-22: Importance of Participation in Efficiency Maine Appliance Rebate Program on Decision to Purchase Energy-Efficient Products Not Covered by Efficiency Maine Rebate or Program

(Base: Respondents that purchased energy-efficient products not covered by Efficiency Maine Rebate or Program)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*14*	*12*	*5*	*13*	*18*	*62*	*62*
Mean	5.0	2.6	5.3	3.0	4.1	3.9	*3.7*
Low Importance (0-3)	6 (35%)	9 (69%)	2 (33%)	9 (60%)	8 (42%)	49%	53%
Moderate Importance (4-6)	3 (18%)	1 (8%)	1 (17%)	2 (13%)	4 (21%)	16%	13%
High Importance (7-10)	7 (41%)	3 (23%)	3 (50%)	4 (27%)	5 (26%)	31%	32%
Don’t know/Don’t remember or Refused	1 (6%)	0	0	0	2 (11%)	4%	3%

A.8 Other Efficiency Maine Programs

Table A-23: Participation in Other Efficiency Maine Programs

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*382*	*382*
Yes	18%	18%	17%	19%	23%	19%	18%
No	77%	79%	77%	81%	78%	78%	78%
Don't know/Don't remember or Refused	5%	4%	6%	0%	0%	0%	4%

Table A-24: Participation in Other Efficiency Maine Programs – Multiple Response

(Base: Respondents that participated in other Efficiency Maine programs)

Efficiency Maine Program	Refrig-erators (count)	Clothes Washers (count)	De-humidifiers (count)	Room ACs, Freezers, & Room Air Purifiers (count)	Heat Pump Water Heaters (count)	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*19*	*14*	*8*	*13*	*18*	*72*	*72*
Another appliance through Appliance Program	8 (40%)	4 (29%)	1 (13%)	6 (46%)	6 (32%)	34%	34%
Residential Lighting Program (CFLs or LEDs)	5 (25%)	1 (7%)	3 (40%)	2 (15%)	2 (11%)	18%	17%
Home Energy Savings Program	3 (15%)	3 (21%)	1 (13%)	0	2 (11%)	12%	16%
Residential Air Sealing Promotion	1 (5%)	1 (7%)	1 (13%)	1 (8%)	1 (5%)	7%	6%
Solar/wind rebate program	0	0	0	0	4 (21%)	5%	<1%
Maine PACE/PowerSaver Financing Program	0	0	0	0	1 (5%)	1%	<1%
Other	0	0	0	1 (8%)	0	1%	1%
Don’t know/Don’t remember or Refused	3 (15%)	5 (36%)	2 (25%)	3 (23%)	3 (16%)	20%	23%

A.10 Free CFLs

When filling out their appliance rebate form, participants had the option to check off a box to receive a free six-pack of CFLs from Efficiency Maine. Most survey respondents who checked off the CFL box (84%) recalled receiving the six-pack of CFLs in the mail (Table A-25). The remaining respondents may not have received the CFLs at the time of the survey, are simply may not recall it.

Table A-25: Whether Participant Received Free CFLs

(Base: All survey respondents)

	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*314*	*314*
Yes	85%	84%
No	12%	12%
Don't know/Don't remember or Refused	3%	4%

Of those respondents who had received the free CFLs through the program, nearly three out of four (74%) reported installing at least one of the six bulbs (Table A-26).

Table A-26: Whether Participant Installed Any Free CFLs

(Base: Respondents that received free CFLs)

	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*267*	*267*
Yes	69%	74%
No	32%	26%

On average, 2.6 bulbs per household were installed by respondents that received the free CFLs. One out of four respondents (26%) indicated having installed all six bulbs, with the identical percentage indicating not having installed any of them at the time of the survey (Table A-27).

Table A-27: Number of Installed Free CFLs

(Base: Respondents that received free CFLs)

Number of CFLs Installed	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*267*	*267*
Average	2.6	2.8
0 (no CFLs installed)	32%	26%
1	5%	5%
2	15%	17%
3	11%	13%
4	8%	6%
5	2%	2%
6 (all CFLs installed)	24%	26%
Don’t know/Don’t remember or Refused	5%	5%

Respondents who had installed fewer than six of the free CFLs were asked why not all of the bulbs were currently installed. The majority of respondents (84%) said the bulbs were not currently installed because the old bulbs haven't burned out yet, indicating that their lack of full installation was not related to any issues with bulb quality, but simply not having the necessity for them at the time of the survey (Table A-28).

Table A-28: Reasons Why Not All Free Bulbs Currently Installed

(Base: Respondents that installed fewer than six free CFLs)

	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*191*	*191*
Old bulbs haven't burned out yet	81%	84%
Saving as a back-up/don't need them	5%	3%
Life span	2%	2%
Does not fit in the fixture	1%	2%
Need lower wattage than bulbs received	1%	2%
Have not had time yet	2%	1%
Don't like the look/appearance of CFLs	1%	1%
Bulbs not bright enough	1%	1%
Some/all have broken	1%	1%
Already had other CFLs installed	2%	<1%
Prefer incandescent bulbs	1%	<1%
Don't like performance of CFLs	1%	<1%
Don't work with dimmer /3-way switch	1%	<1%
Other	2%	1%
Don't know/Don't remember or Refused	2%	1%

Table A-29 illustrates the number and type of bulbs the CFLs from Efficiency Maine had replaced in respondents' homes. While more than one-half of the free CFLs (55%) provided had yet to be installed, of the 45% of CFLs that had been installed, the majority had replaced standard incandescent bulbs (81%). Only 16% of installed CFLs had replaced other CFLs, and a small number had replaced halogen bulbs (1%) or LED light bulbs (<1%).

Table A-29: Number of Bulbs Replaced by Free CFLs

(Base: Respondents that have installed at least one free CFL)

Type of bulb replaced by Free CFL	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*164*	*164*
Total number of free CFLs provided	1,518	1,578
Total number of CFLs not yet installed	889 (59%)	852 (55%)
Total number of CFLs installed	629 (41%)	696 (45%)
Installed CFLs		
Standard Incandescent or regular light bulbs	522 (83%)	565 (81%)
Other compact fluorescent bulbs or CFLs	92 (15%)	113 (16%)
Halogen bulbs that screw into regular light sockets	5 (1%)	8 (1%)
LED light bulbs that screw into regular light sockets	5 (1%)	3 (<1%)
Some other type of bulb	1 (1%)	7 (1%)

Participants that had installed at least one free CFL rated their level of satisfaction with the performance of the bulbs on a scale of one (not at all satisfied) to five (very satisfied). Most respondents (90%) were either somewhat or very satisfied with the performance of the free CFLs (Table A-30).

Table A-30: Level of Satisfaction with Performance of Free CFLs

(Base: Respondents that have installed at least one free CFL)

Type of bulb replaced by Free CFL	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*171*	*171*
Very satisfied	67%	64%
Somewhat satisfied	23%	26%
Neither satisfied nor unsatisfied	4%	3%
Somewhat unsatisfied	4%	3%
Not at all satisfied	3%	3%
Don't know/Don't remember or Refused	1%	1%

Since receiving the six-pack of free CFLs from Efficiency Maine, just over one-fourth (27%) of respondents that had installed at least one free CFL had installed additional CFLs that were not part of the free six-pack (Table A-31).

Table A-31: Whether Additional CFLs Have Been Installed since Receiving Free CFLs

(Base: Respondents that have installed at least one free CFL)

	All Survey Respondents	Overall Program (weighted)
Sample Size	*267*	*267*
Yes	26%	27%
No	73%	71%
Don't know/Don't remember or Refused	2%	2%

Participants that had installed additional CFLs rated the level of importance that receiving free CFLs from Efficiency Maine had on their decision to install the additional CFLs on a scale from zero to ten. As shown in Table A-32, responses were spread fairly evenly, with 34% saying the free CFLs had a high importance level, 23% citing moderate importance, and 43% indicating it had low importance.

Table A-32: Importance of Free CFLs on Decision to Install Additional CFLs

(Base: Respondents that have installed additional CFLs)

	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*69*	*69*
Mean	4.6	4.6
Low Importance (0-3)	39%	43%
Moderate Importance (4-6)	26%	23%
High Importance (7-10)	35%	34%

A.11 Demographics

Table A-33: Type of Home

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year data)
Number of Respondents	*100*	*74*	*48*	*69*	*75*	*68*	*366*	*366*	*722,645***
Detached single-family home	77%	78%	92%	68%	87%	85%	80%	78%	70%
Mobile home or manufactured home	7%	7%	2%	16%	1%	2%	7%	7%	9%
Attached single-family home	5%	12%	4%	4%	5%	9%	6%	8%	2%
Two-family building	9%	1%	2%	3%	3%	2%	4%	5%	5%
Three- or Four-family building	0%	1%	0%	3%	4%	0%	2%	1%	5%
Part of a building with five or more units	2%	0%	0%	4%	0%	0%	1%	1%	9%
Other	0%	0%	0%	1%	0%	2%	<1%	<1%	<1%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total housing units.

Table A-34: When Home was Built

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year data)
Number of Respondents	*101*	*76*	*48*	*68*	*80*	*70*	*373*	*373*	*722,645***
1930s or earlier	20%	20%	13%	18%	29%	23%	20%	19%	27%
1940s	3%	1%	0%	2%	3%	4%	2%	2%	5%
1950s	9%	7%	6%	9%	4%	10%	7%	8%	8%
1960s	7%	5%	13%	10%	9%	10%	8%	7%	7%
1970s	23%	17%	19%	6%	13%	13%	16%	19%	14%
1980s	17%	15%	10%	6%	13%	14%	13%	15%	15%
1990s	9%	12%	19%	19%	14%	11%	14%	12%	12%
2000 or later	13%	24%	21%	31%	18%	14%	20%	20%	11%

* Don’t know, Don’t remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total housing units.

Table A-35: Tenure

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year data)
Number of Respondents	*103*	*79*	*48*	*68*	*80*	*70*	*378*	*378*	*554,289***
Own/Buying	97%	94%	100%	85%	100%	100%	95%	95%	72%
Rent/Lease	3%	6%	0%	15%	0%	0%	5%	5%	28%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total occupied housing units.

Table A-36: Number of Months per Year Home is Occupied

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*70*	*382*	*382*
All year	92%	95%	94%	91%	94%	90%	93%	94%
8 to 11 months	4%	3%	4%	1%	4%	10%	3%	2%
5 to 7 months	2%	1%	2%	4%	3%	0%	2%	3%
Don't know/Don't remember or Refused	2%	1%	0%	3%	0%	0%	1%	2%

Table A-37: Primary Type of Fuel Used to Heat Home

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year data)
Number of Respondents	*102*	*78*	*48*	*68*	*79*	*70*	*375*	*375*	*554,289***
Fuel oil, kerosene, etc.	60%	54%	81%	68%	46%	60%	60%	59%	70%
Wood	22%	26%	13%	15%	34%	31%	23%	23%	12%
Utility gas	6%	5%	2%	13%	8%	3%	7%	6%	5%
Bottled tank or LP gas	8%	13%	2%	4%	1%	1%	6%	10%	7%
Electricity	4%	0%	2%	0%	11%	4%	4%	2%	5%
Other fuel	1%	3%	0%	0%	0%	0%	1%	2%	1%
No fuel used	0%	0%	0%	0%	0%	0%	0%	0%	<1%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total occupied housing units.

Table A-38: Primary Type of Fuel Used to Heat Hot Water

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*70*	*382*	*382*
Fuel oil, heating oil, or #2 oil	50%	51%	77%	57%	11%	53%	47%	52%
Electricity	25%	23%	10%	20%	83%	39%	34%	24%
Natural Gas from underground pipes	8%	10%	2%	10%	3%	3%	7%	9%
Bottled or tank gas (LP, propane, butane)	10%	9%	2%	4%	0%	0%	6%	8%
Wood	2%	4%	4%	3%	1%	1%	3%	3%
Solar	1%	0%	0%	1%	0%	0%	1%	1%
Off the boiler/same as boiler	0%	1%	2%	1%	0%	0%	1%	1%
Bio-fuel	1%	0%	0%	0%	0%	0%	<1%	<1%
Oil and wood	1%	0%	0%	0%	0%	0%	<1%	<1%
Wood pellets	0%	0%	2%	0%	0%	0%	<1%	<1%
Hybrid	0%	0%	0%	0%	1%	1%	<1%	0%
Don’t know/Don’t remember or Refused	3%	3%	0%	3%	1%	3%	2%	3%

Table A-39: Size of Home

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*70*	*382*	*382*
Less than 1,000 ft^2	11%	9%	8%	13%	5%	7%	9%	10%
1,000 to less than 1,500 ft^2	13%	34%	19%	19%	19%	17%	18%	19%
1,500 to less than 2,000 ft^2	22%	15%	25%	21%	20%	25%	20%	19%
2,000 to less than 2,500 ft^2	14%	9%	21%	17%	24%	15%	16%	12%
2,500 to less than 3,000 ft^2	9%	11%	4%	0%	9%	3%	7%	9%
3,000 to less than 4,000 ft^2	6%	4%	2%	4%	11%	13%	6%	5%
4,000 to less than 5,000 ft^2	3%	1%	2%	1%	3%	6%	2%	2%
5,000 ft^2 or more	6%	4%	4%	3%	3%	0%	4%	5%
Don't know/Don't remember or Refused	18%	23%	15%	21%	8%	13%	17%	21%

Table A-40: Number of Rooms in Home

(Base: All Survey Respondents*)

Number of rooms (not including: bathrooms, halls, garages, porches, unfinished rooms)	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year Data)
Number of Respondents	*100*	*74*	*48*	*67*	*78*	*69*	*367*	*367*	*722,645***
Mean # of rooms	6.2	6.4	6.2	6.2	7.0	7.0	6.4	6.3	-
Median rooms	6	6	6	6	7	7	6	6	5.3
1 room	1%	0%	0%	0%	0%	0%	<1%	<1%	2%
2 rooms	0%	0%	0%	5%	0%	0%	1%	<1%	3%
3 rooms	7%	4%	4%	2%	1%	3%	4%	5%	9%
4 rooms	6%	13%	13%	17%	5%	6%	10%	10%	18%
5 rooms	21%	26%	19%	23%	22%	16%	23%	24%	20%
6 rooms	29%	16%	25%	16%	21%	19%	22%	22%	18%
7 rooms	12%	20%	19%	16%	18%	23%	17%	16%	12%
8 rooms	13%	8%	13%	11%	17%	17%	12%	11%	8%
9 rooms or more	10%	13%	8%	11%	16%	16%	12%	12%	9%

* Don’t know, Don’t remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total housing units.

Table A-41: Number of Bedrooms in Home

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year Data)
Number of Respondents	*100*	*74*	*48*	*67*	*78*	*68*	*367*	*367*	*722,645***
Mean # of bedrooms	3.1	3.0	3.3	3.0	3.3	3.3	3.1	3.1	n/a
No bedrooms	0%	0%	0%	0%	0%	0%	0%	0%	3%
1 bedroom	2%	4%	0%	5%	1%	2%	3%	3%	12%
2 bedrooms	22%	18%	21%	30%	20%	18%	22%	21%	31%
3 bedrooms	51%	60%	52%	44%	47%	41%	51%	54%	38%
4 bedrooms	17%	12%	15%	19%	20%	28%	17%	15%	13%
5 or more bedrooms	8%	7%	13%	3%	13%	12%	9%	7%	4%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total occupied housing units.

Table A-42: Age of Respondent

(Base: All Survey Respondents)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year Data)
Number of Respondents	*95*	*71*	*46*	*63*	*78*	*69*	*353*	*353*	*1,328,387*[*]
19 and under	0%	2%	0%	0%	0%	0%	<1%	1%	23%
20 to 24	0%	2%	0%	2%	0%	0%	1%	1%	6%
25 to 34	6%	13%	7%	15%	13%	9%	11%	10%	11%
35 to 44	10%	22%	15%	18%	23%	17%	17%	16%	13%
45 to 54	26%	21%	22%	15%	31%	22%	23%	22%	16%
55 to 59	20%	10%	11%	10%	8%	12%	13%	14%	8%
60 to 64	20%	9%	17%	10%	16%	17%	15%	14%	7%
65 to 74	15%	16%	22%	23%	8%	22%	16%	16%	9%
75 to 84	1%	4%	7%	5%	0%	1%	3%	3%	5%
85 years and over	2%	2%	0%	3%	1%	0%	2%	2%	2%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total population.

Table A-43: Level of Education

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year Data)
Number of Respondents	*99*	*76*	*48*	*63*	*78*	*68*	*364*	*364*	*938,148***
Less than Ninth Grade	0%	1%	0%	3%	0%	0%	1%	1%	4%
9th to 12th Grade	2%	1%	0%	2%	1%	3%	1%	2%	6%
High School Graduate (includes GED)	14%	14%	6%	23%	11%	10%	14%	14%	34%
Some College, No Degree	17%	16%	15%	13%	16%	12%	16%	16%	20%
Associates Degree	13%	12%	17%	13%	19%	19%	15%	13%	9%
Bachelors Degree	26%	29%	21%	27%	32%	27%	27%	27%	18%
Graduate or Professional Degree	28%	26%	42%	18%	21%	29%	26%	27%	10%

* Don’t know, Don’t remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total population 25 years and older.

Table A-44: Number of People Living in Home

(Base: All Survey Respondents*)

Number of people	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year Data)
Number of Respondents	*101*	*78*	*48*	*67*	*80*	*70*	*374*	*374*	*554,289***
1	11%	7%	8%	11%	7%	6%	9%	9%	28%
2	56%	47%	67%	50%	40%	49%	51%	52%	39%
3	15%	27%	10%	23%	14%	19%	18%	21%	16%
4	13%	11%	10%	8%	22%	17%	13%	12%	12%
5	4%	4%	4%	3%	8%	6%	5%	4%	4%
6	0%	4%	0%	5%	7%	1%	3%	2%	1%
7 or more	0%	1%	0%	0%	3%	3%	1%	1%	1%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data

** Total occupied housing units.

Table A-45: Level of Income

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year Data)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*70*	*382*	*382*	*554,289***
Low income	5%	9%	6%	17%	16%	9%	11%	8%	22%
Not low income	95%	91%	94%	83%	84%	91%	90%	92%	78%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total occupied housing units.

Table A-46: Gender

(Base: All Survey Respondents*)

	Refrig-erators	Clothes Washers	De-humidifiers	Room ACs, Freezers, & Room Air Purifiers	Heat Pump Water Heaters	All Onsite Respondents	All Survey Respondents	Overall Program (weighted)	Maine (ACS 3-year Data)
Number of Respondents	*104*	*80*	*48*	*70*	*80*	*70*	*382*	*382*	*1,328,387***
Male	49%	56%	60%	57%	70%	67%	58%	54%	49%
Female	51%	44%	40%	43%	30%	33%	42%	46%	51%

* Don't know, Don't remember, and Refused survey responses removed in order to facilitate comparison with ACS data.

** Total population.

Appendix B Database Review Corrections

Tables

A common exercise for the four priority measures was a detailed data cleaning of the program database in order to append additional details available through ENERGY STAR QPLs. For each measure, modifications were required to make mapping possible for some units. At the same time, the evaluation team was able to screen out units that appeared to be ineligible for the program. Details for each of the four priority measures are provided in the following subsections.

B.1 Refrigerator Database Review

As described in Section 2.1.1, the evaluation team performed a review of the refrigerator database. Of the 8,353 refrigerators found in the database extract, the evaluation team was able to map 7,911 directly to the ENERGY STAR certified residential refrigerator list[68]. Seventy-six of these refrigerators, representing eight manufacturer and model number combinations, were not direct matches but were categorized correctly due to the use of wildcards (*). This error is relatively harmless, but does represent some inconsistency in the program implementer's data entry processes. Modifications of this nature are listed in Table B-1.

[68] United States Environmental Protection Agency (USEPA), ENERGY STAR Certified Residential Refrigerator List, January 2014. http://www.energystar.gov/productfinder/download/certified-residential-refrigerators/

Table B-1 Refrigerator Model Number Revisions Due to Wildcard Effect

Original Manufacturer	Original Model Number	Revised Manufacturer	Revised Model Number	Quantity
BOSCH	B22CS30*N*	BOSCH	B22CS30SN*	4
GE PROFILE	PFSS2MJY**	GE PROFILE	PFSS2MJY****	9
GE	GFSF2HCY**	GE	GFSF2HCY****	47
KENMORE	6900*	KENMORE	6900#	2
KENMORE	7809*	KENMORE	7809#	8
KENMORE	7900*	KENMORE	7900#	3
KITCHENAID	KBRS22KW*	KITCHENAID	KBRS22KW**	1
WHIRLPOOL	WRT359SF*0*	WHIRLPOOL	WRT359SFY*0*	2

Of the remaining 442 refrigerators, 339 were mapped to the QPL after minor corrections, e.g., revising manufacturer names from "LG" to "LG ELECTRONICS" and "GE" to "GE PROFILE", representing 38 manufacturer and model number combinations. This error is also relatively harmless, but it does create the need to QA/QC the database and increase level of effort required by the program administrator to map program refrigerators to other lists, such as the QPL and CEE lists, which may be helpful to identify additional program metrics such as adjusted volume and rated annual kWh consumption. Modifications of this nature are listed in Table B-2.

Table B-2: Refrigerator Manufacturer and Model Number Revisions

Original Manufacturer	Original Model Number	Revised Manufacturer	Revised Model Number	Quantity
DANBY	DAR1102WE	DANBY DESIGNER	DAR1102WE	9
ELECTROLUX	EI23BC36IS*	ELECTROLUX	EI23BC36I*	1
ELECTROLUX	EI23BC56I	ELECTROLUX	EI23BC56I*	1
ELECTROLUX	FGHB2844L*	FRIGIDAIRE	FGHB2844L*	21
FRIDGIDAIRE	FFHT1725P*	FRIGIDAIRE	FFHT1725P*	2
FRIGIDAIRE	FGUI2149L*	GALLERY	FGUI2149L*	6
FRIGIDAIRE	FGUS2647L*	GALLERY	FGUS2647L*	1
FRIGIDAIRE	FPRH19D7LF	FRIGIDAIRE	FPRH19D7L*	7
FRIGIDAIRE	LFHT1513LW	FRIGIDAIRE	LFHT1513L*	25
FRIGIDAIRE	LGHT2137L*	GALLERY	LGHT2137L*	25
GALLERY	FGHN2844L*	FRIGIDAIRE	FGHN2844L*	13
GE	CFSP5RKB****	GE CAFE	CFSP5RKB****	9
GE	PFSF0MFZ****	GE PROFILE	PFSF0MFZ****	2
GE	PFSS0MFZ****	GE PROFILE	PFSS0MFZ****	1
GE PROFILE	PFSF6PKX****	PROFILE	PFSF6PKX****	1
GE PROFILE	PFSS9PKY****	PROFILE	PFSS9PKY****	1
GE PROGILE	PFSF5RKZ****	GE PROFILE	PFSF5RKZ****	2
GENERAL ELEC	PFCF1NFZ****	GE PROFILE	PFCF1NFZ****	2
JENN-AIR	JFX2597AE**	JENN AIR	JFX2597AE**	15
JENN-AIR	JSC24C8EA*0*	JENN AIR	JSC24C8EA*0*	2
KENMORE	401.404838	KENMORE	401.40483800	1
KENMORE	44743	KENMORE	44743.0	2
KENMORE	6889	KENMORE	2536889*01	25
LG	LFC20770**	LG ELECTRONICS	LFC20770**	30
LG	LTC19340**	LG ELECTRONICS	LTC19340**	1
LG ELECTRONICS	LFC21776**	LG	LFC21776**	8
LG ELECTRONICS	LFC25776**	LG	LFC25776**	38
LG ELECTRONICS	LFX25974**	LG	LFX25974**	39
LIEBHERR	RB* 1410	LIEBHERR	RB*1410	1
MAYTAG	MBF2258XEB	MAYTAG	MBF2258XE*	27
MAYTAG	MFI2665XEB	MAYTAG	MFI2665XE*	12
MIELE	KF 1911 **	MIELE	KF 1911**	1
SUB-ZERO	736TR	SUB-ZERO, INC.	736TR	1
SUB-ZERO	BI36R*	SUB-ZERO, INC.	BI-36R/*	1
SUB-ZERO	BI36U*	SUB-ZERO, INC.	BI-30U/*	2
SUB-ZERO	BI-48S/S/**	SUB-ZERO, INC.	BI-48S/S/**	1
THERMADOR	T30IR800SP	SIEMENS	T30IR800SP	1
THERMADOR	T36IB800SP	SIEMENS	T36IB800SP	2

The remaining 103 refrigerators can be divided into two groups. The evaluation team determined that 55 refrigerators, representing 13 manufacturer and model number combinations, were ENERGY STAR certified at some point, labeled as former ENERGY STAR refrigerators. The evaluation team found that the majority of these refrigerators had been discontinued and that they were likely being sold as refurbished refrigerators. During their original production, they were likely branded as ENERGY STAR certified refrigerators, but were no longer being manufactured when the most recent QPL was published. These models are listed in Table B-3.

Table B-3: Former ENERGY STAR Refrigerators

Manufacturer	Model Number	Quantity
AMANA	ABR2222FE*	1
FISHER & PAYKEL	RF175A	1
FRIGIDAIRE	PHT219H*	1
GE	GSHF3KGX***	1
GE	GSHL5KGX***	1
GE	GTH17DBC****	1
GE	GTH21SBXSS	3
GE	GTH21SCXSS	1
KENMORE	5110*11*	40
MAYTAG	MBF1958WE*	1
MAYTAG	MBR2556KE*	1
SAMSUNG	RF217AB**	1
WHIRLPOOL	ED5PVE*V*0*	2

The evaluation team determined, based on estimated rated kWh and knowledge of the federal standards, that the remaining 48 refrigerators, representing 19 manufacturer and model number combinations, did not meet the ENERGY STAR criteria at the time of manufacture and therefore were never ENERGY STAR qualified. The current ENERGY STAR specification for refrigerators was last updated in 2008, leading the evaluation team to have confidence that these refrigerators were not ENERGY STAR qualified at a previous time. The repercussions of this issue are obvious in that these models were incented by the program but achieve no savings. These models are listed in Table B-4.

Table B-4: Ineligible Refrigerators

Manufacturer	Model Number	Quantity
AMANA	ABB2224DE*	1
AMANA	AFD2535FE*	9
CROSLEY	LFTR1814L*	4
FRIGIDAIRE	FRT18L4J*	4
GE	GFSF2KEX***	1
GE	GSS20GEW****	4
GE	PTS22SHS****	1
GE CAFE	CFCP1NIZ****	5
HOTPOINT	HTR16ABS****	1
KENMORE	2536880*01	5
KENMORE	2536888*01	2
KENMORE	2537888*01	1
MAYTAG	AFD2535DE*	2
MAYTAG	MFC2061KE*	1
WHIRLPOOL	ER2CHM*P*0*	1
WHIRLPOOL	W4TNXWFW*0*[1]	1
WHIRLPOOL	W8TXNGFW*0*	1
WHIRLPOOL	W8TXNGMW*0*	3
WHIRLPOOL	W9TXNMFW*0*	1

[1] The evaluation team was unable to identify information on this model number, but posits that it was a typo of "W4TXNWFW*0*", which is not ENERGY STAR certified.

B.2 Clothes Washer Database Review

As described in Section 2.1.2, the evaluation team performed a review of the clothes washer database. Of the 9,279 clothes washers found in the database extract, the evaluation team was able to map 8,598 directly to the clothes washer QPLs.[69] Of the remaining 689 clothes washers, 681 were mapped to the QPLs after minor corrections, e.g., revising model number from "MHWE950W#**" to "MHWE950W*+", and manufacturer names from "KENMORE ELITE" to "KENMORE", representing 14 manufacturer and model number combinations. Modifications of this nature are listed in Table B-5.

[69] Refer to Section 2.1.2.2 for more information on the use of multiple QPLs.

Table B-5: Clothes Washer Manufacturer and Model Number Revisions

Original Manufacturer	Original Model Number	Revised Manufacturer	Revised Model Number	Quantity
ELECTROLUX	EIFLS55I***	ELECTROLUX	EIFLS55***	33
ELECTROLUX	EIFLW55H	ELECTROLUX	EIFLW55**	1
GE	GFWN1100L	GE	GFWN1100L***	7
GE	WCVH6800J	GE	WCVH6800J***	12
KENMORE[1]	2600*01+	KENMORE	2600*10+	131
KENMORE[1]	2800*01+	KENMORE	2800*10+	33
KENMORE	410##90#	KENMORE	4102#90#	2
KENMORE ELITE	2927#00#	KENMORE	2927#00#	8
MAYTAG	MHW7000XW1	MAYTAG	MHW7000X*+	1
MAYTAG	MHWE450W#**	MAYTAG	MHWE450W*+	4
MAYTAG	MHWE950W#**	MAYTAG	MHWE950W*+	25
MAYTAG	MVWB750W#**	MAYTAG	MVWB750W*+	4
MAYTAG	MVWB850W#**	MAYTAG	MVWB850W*+	5
WHIRLPOOL	WFW94HEXW1	WHIRLPOOL	WFW94HEX*+	1

[1] While model number revisions for these units were not intuitive (like the majority of these corrections), the evaluation team believes that the revised model numbers correct for mislabeling of these clothes washers.

Of the eight remaining units, the evaluation team determined that six units, or four manufacturer and model number combinations, exceeded ENERGY STAR criteria, based on successful matches with the CEE lists. These units are presented in Table B-6.

Table B-6: CEE Tiered Clothes Washers

Manufacturer	Model Number	CEE Tier	Quantity
BOSCH	WFVC8440UC	3	1
LG	WM3987H**	3	3
LG ELECTRONICS	WM3885H***	3	1
WHIRLPOOL	WFW8200T*+	2	1

The remaining two units represent two manufacturer and model number combinations that the evaluation team determined to be non-ENERGY STAR certified, and therefore ineligible for the program. These units are presented in Table B-7.

Table B-7: Ineligible Clothes Washers

Manufacturer	Model Number	Quantity
LG	WM3455H*	1
WHIRLPOOL	WTW6200V#**	1

B.3 Dehumidifier Database Review

As described in Section 2.1.3.2, the evaluation team performed a review of the dehumidifier database. Of the 906 dehumidifiers found in the database extract, the evaluation team was able to map 516 directly to the dehumidifier QPLs.[70] Of the remaining 390 dehumidifiers, 388 were mapped to the QPLs after minor corrections, e.g., revising manufacturer names from "LG ELECTRONICS" to "LG" and "MIDEA" to "SPT", representing 20 manufacturer and model number combinations. This error is also relatively harmless, but it does create the need to QA/QC the database and increase level of effort required by the program administrator to map program refrigerators to other lists, such as the QPL and CEE lists, which may be helpful to identify additional program metrics such as capacity and energy factor. Modifications of this nature are listed in Table B-8.

Table B-8: Dehumidifier Manufacturer and Model Number Revisions

Original Manufacturer	Original Model Number	Revised Manufacturer	Revised Model Number	Quantity
ELECTROLUX	FAD301NUD	FRIGIDAIRE	FAD301NUD	3
GE	ADEL70LRL1	GE	ADEW70LRL1	2
GREE	ADEH50LQ**	GE	ADEH50LQ**	2
LG	LD650EAL	LG	LD650EALY1	9
LG ELECTRONICS	LD651EBL	LG	LD651EBL	88
MIDEA	PA50	PERFECT AIR	PA50	1
MIDEA	SD-65E	SPT	SD-65E	2
MIDEA USA	PA30	PERFECT AIR	PA30	3
MIDEA USA	SYL-30ES	SYLVANIA	SYL-30ES	4
SOLEUSAIR	GL-DEH-70-2**	SOLEUSAIR POWERED BY GREE	GL-DEH-70-2**	54
SOLEUSAIR	GL-DEH-30-1	SOLEUSAIR POWERED BY GREE	GL-DEH-30-1	9
SOLEUSAIR	SG-DEH-25-4	SOLEUSAIR POWERED BY GREE	SG-DEH-25-4	42
SOLEUSAIR	GL-DEH-70P-2**	SOLEUSAIR POWERED BY GREE	GL-DEH-70P-2**	15
SOLEUSAIR	GL-DEH-45-2	SOLEUSAIR POWERED BY GREE	GL-DEH-45-2	1
SOLEUSAIR	SG-DEH-70-1	SOLEUSAIR POWERED BY GREE	SG-DEH-70-1	1
SOLEUSAIR	GL-DEH-70EIP-6**	SOLEUSAIR POWERED BY GREE	GL-DEH-70EIP-6**	27
SOLEUSAIR	SG-DEH-45-1	SOLEUSAIR POWERED BY GREE	SG-DEH-45-1	1
SOLEUSAIR POWER	GL-DEH-50-2**	SOLEUSAIR POWERED BY GREE	GL-DEH-50-2**	117
SYLVANIE	SYL-65ES	SYLVANIA	SYL-65ES	1
WINIX	90701	KENMORE ELITE	90701	6

[70] Refer to Section 2.1.3.2 for more information on the use of multiple QPLs.

The evaluation team was unable to map two dehumidifiers to any existing QPL, but identified one that was ENERGY STAR certified and one that was not. These are presented in Table B-9 and Table B-10.

Table B-9: Former ENERGY STAR Dehumidifiers

Manufacturer	Model Number	Quantity
GE	ADEH50LN	1

Table B-10: Ineligible Dehumidifiers

Manufacturer	Model Number	Quantity
SOLEUSAIR	GL-DEH-70F-2**	1

B.4 Heat Pump Water Heater Database Review

As described in Section 2.1.4, the evaluation team performed a review of the heat pump water heater database. Of the 281 heat pump water heaters found in the database extract, the evaluation team was able to map 257 directly to the ENERGY STAR certified water heater list.[71] Of the remaining 24 units, 18 units representing four manufacturer and model number combinations were mapped to the QPL after minor modifications. These modifications are presented in Table B-11.

Table B-11: Heat Pump Water Heater Manufacturer and Model Number Revisions

Original Manufacturer	Original Model Number	Revised Manufacturer	Revised Model Number	Quantity
A.O. SMITH	PHPT-60	A. O. SMITH	PHPT 60 102	7
STATE	EPX 60 DHPT	STATE	EPX 60 DHPT 102	7
US CRAFTMASTER	HPE2K80HD045V (USC)	US Craftmaster, Whirlpool	HPE2K80HD045V 102	1
WHIRLPOOL	HPE2K80HD045V (WP)	US Craftmaster, Whirlpool	HPE2K80HD045V 102	3

[71] United States Environmental Protection Agency (USEPA), ENERGY STAR Certified Water Heater List, January 2014. http://www.energystar.gov/productfinder/download/certified-water-heaters/

The evaluation team determined that the remaining six units representing four manufacturer and model number combinations met ENERGY STAR certified after review of specifications and cut sheets. These units are presented in Table B-12.

Table B-12: Unlisted ENERGY STAR Heat Pump Water Heaters

Original Manufacturer	Original Model Number	Quantity
GE	GEH50DNSR***	3
HTP	HPW-50-6	1
RHEEM	HP40ES	1
RHEEM	HP50ES	1

Appendix C On-site Free CFL Data Collection

Tables

All Appliance Rebate Program participants had the option of requesting free CFLs from the program. The evaluation team leveraged the on-site visits to perform a short walk-through audit for customers who opted to receive a CFL and asked several questions.

Based on survey results, 313 (82%) of the 382 participants received free CFLs. Screening the survey results for only those participants that received an on-site visit, 57 (81%) of the 70 participants received free CFLs. Fifty-one (73%) of the 70 participants indicated that they had received the bulbs. These numbers are presented in Table C-1.

Table C-1: CFL Requests and Receipts

Method	Total	Requested or Received CFLs	Did not Request or Receive CFLs
Participant Telephone Survey (All respondents)	382	313	69
Participant Telephone Survey (On-site visit respondents only)	70	57	13
On-site Interview	70	51	19

Of the 51 customers who received the free CFL bulbs, three received twelve bulbs for participating in the program multiple times. In total, 324 bulbs were distributed by the program to the sample population. Table C-2 shows the number of CFLs received by each participant.

Table C-2: CFLs Received by On-site Participants

# of CFLs Received	# of Participants
0	19
6	48
12	3
OVERALL	**70**

Customers responded that 133 (41%) of the 324 bulbs had been installed in a socket at the time of the visit. Table C-3 presents the number of CFLs installed by each participant.

Table C-3: CFLs Installed

# of CFLs Installed	# of Participants
0	17
1	3
2	8
3	8
4	3
5	0
6	11
12	1
OVERALL	**51**

Of the three customers that received 12 CFL bulbs, one installed all 12, another installed three, and the last installed none.

The evaluation team also collected data on the type of bulb that the CFL replaced. Customer responses are presented in Table C-4.

Table C-4: Replaced Bulb

# of CFLs Installed	# of Bulbs
13W CFL	5
14W CFL	5
23W CFL	2
25W Incandescent	2
40W Incandescent	8
43W Halogen	1
60W Incandescent	76
75W Incandescent	4
100W Incandescent	6
Incandescent, Wattage Unknown	9
CFL, Wattage Unknown	7
New Socket	2