

Draft Report

Residential Appliance Efficiency Program Evaluation

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Submitted to:



Submitted by:



ADM Associates, Inc.

3239 Ramos Circle
Sacramento, CA 95827
916.363.8383

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1. Executive Summary

This report presents the results of an evaluation of the Sacramento Municipal Utility District's (SMUD) Residential Appliance Efficiency Program (Appliance Program), for years 2010, 2011 and 2012. The Appliance Program offers incentives for customers to purchase and install energy efficient home appliances. The 2010-2012 Program consisted of downstream rebates for efficient clothes washers, dishwashers, refrigerators, and room air conditioners. There were also incentives available for efficient pool pumps and refrigerator recycling, but these program aspects were not addressed as part of this evaluation. Table 1 presents a summary of program participation by year, appliance, and efficiency level. Efficiency levels are categorized by the Consortium of Energy Efficiency's (CEE) Super Efficient Home Appliance Tiers. The tiers refer to specific energy savings criteria above the Federal standard minimum. Higher tiers represent more efficient appliances.

Table 1: Summary of Rebated Appliances¹

| <i>Measures</i> | <i>Quantity Rebated</i> | | | |
|------------------------------|-------------------------|--------------|--------------|--------------|
| | <i>2010</i> | <i>2011</i> | <i>2012</i> | <i>Total</i> |
| Clothes Washers | 916 | 629 | 519 | 2,064 |
| CEE Tier 1 (2010) | 62 | 0 | 0 | 62 |
| CEE Tier 2 (2010) | 50 | 0 | 0 | 50 |
| CEE Tier 3 (2010) | 804 | 0 | 0 | 804 |
| CEE Tier 1 (2011&2012) | 0 | 11 | 18 | 29 |
| CEE Tier 2 (2011&2012) | 0 | 80 | 22 | 102 |
| CEE Tier 3 (2011&2012) | 0 | 538 | 479 | 1017 |
| Dishwashers | 268 | 251 | 181 | 700 |
| CEE Tier 1 (2010&2011) | 105 | 78 | 1 | 184 |
| CEE Tier 2 (2010&2011) | 163 | 173 | 28 | 364 |
| CEE Tier 1 (2012) | 0 | 0 | 152 | 152 |
| Refrigerators | 0 | 0 | 253 | 253 |
| CEE Tier 3 | 0 | 0 | 253 | 253 |
| Room Air Conditioners | 273 | 219 | 833 | 1,325 |
| CEE Tier 1 | 32 | 18 | 1 | 51 |
| CEE Tier 2 | 241 | 201 | 832 | 1274 |
| Total | 1,457 | 1,099 | 1,786 | 4,342 |

The objectives for this study were to verify, document, analyze and estimate the following aspects of the program:

- Number of appliances rebated through the program;

¹ The CEE tier criteria for clothes washers were updated to more stringent levels in 2011. Similarly, the dishwasher specification was updated in 2012. ADM used the appropriate year's criteria for the purpose of calculating ex post savings estimates.

- Annual gross kWh savings and average coincident peak kW reduction;
- Annual net kWh savings and average coincident peak kW reduction;
- Market penetration and market potential; and,
- Other findings resulting from evaluation activities.

Various data were used to accomplish these objectives including program tracking data, participant and non-participant survey data, shelf-level inventory data, interview data collected on-site and at participating retail stores, and relevant secondary sources. The body of this report is structured as follows:

- Introduction
- Gross Impact Evaluation
- Net Impact Evaluation
- Process Evaluation
- Market Characterization and Other Key Findings
- Program Recommendations

The approach used for the gross impact evaluation was to compare the energy use of rebated appliances to less efficient baseline appliances. The choice of baseline for appliances is not necessarily straightforward. While there are federal and state mandated minimum efficiency regulations, the available stock of appliances is often considerably more efficient than these minimums due largely to technological advances, national energy efficiency initiatives such as ENERGY STAR®, and numerous utility sponsored energy efficiency programs. While reviewing the ex ante savings calculations provided by SMUD, it became clear that the baseline used for these estimates was the federal/state minimum efficiency requirements. For the purpose of comparing “apples-to-apples,” ADM also used minimum efficiency requirements as the baseline from which gross savings estimates are derived. Actual market characteristics for each appliance were then used to adjust savings estimates as part of the net impact evaluation.

The purpose of the net impact evaluation was to estimate the percentage of gross energy impacts and gains in efficiency that are directly attributable to the Appliance Program (i.e., the program’s net impact) and hence to estimate net-to-gross ratios. Our methodology for estimating net-to-gross ratios is an adaptation of the methodology that we have applied in deriving estimates of free-ridership and net-to-gross ratios in previous evaluations of other downstream appliance rebate programs. The approach relies on (1) developing actual market efficiency level baselines for each of the program incentivized appliances and (2) using participant and non-participant self-reported data to assess the likelihood that customers would select efficient home appliances in the absence of program sponsored rebates.

In addition to estimating gross and net impacts, this evaluation also considered a number of process related topics. Examples include customer awareness of the

program, effectiveness of various marketing channels, participant satisfaction, characterization of customer appliance stock, and customer demographics. Retail salesperson interviews were used to obtain information from the retailer perspective regarding marketing effectiveness and customer education. ADM also used customer survey data, shelf-level inventories, and relevant secondary sources to assess market penetration of efficient appliances and market potential for the program in future years.

1.1 Summary of Gross Energy and Peak Demand Impacts

Gross impacts are changes in energy consumption/peak demand that result directly from program-promoted actions regardless of the extent or nature of program influence on these actions. For the Appliance Program, gross impacts represent the difference in energy use between program rebated appliances and minimum efficiency appliances in compliance with federal/state regulations. Total ex post gross annual energy savings estimated through this evaluation are 936,005 kWh for program years 2010-2012. Verified gross coincident peak demand reduction is estimated at 364.6 kW for all three program years. This represents realization rates of 76% for gross annual savings, as compared to ex ante impacts. Table 2 summarizes the gross energy and demand impacts of the Appliance Program by appliance type.

Table 2: Gross Impact Summary by Appliance Type

| <i>Appliance Type</i> | <i>Ex Ante Savings (kWh)</i> | <i>Ex Post Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex Post Peak Demand Savings (kW)</i> |
|-----------------------|------------------------------|------------------------------|-------------------------|---|
| Dishwashers | 74,632 | 24,125 | 32% | 5.06 |
| Clothes Washers | 840,157 | 661,060 | 79% | 85.06 |
| Room ACs | 300,670 | 197,932 | 66% | 265.12 |
| Refrigerators | 23,332 | 52,887 | 227% | 9.35 |
| Total | 1,238,791 | 936,005 | 76% | 364.60 |

Table 3 summarizes the gross energy and demand impacts of the Appliance Program by program year.

Table 3: Gross Impact Summary by Program Year

| <i>Year</i> | <i>Ex Ante Savings (kWh)</i> | <i>Ex Post Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex Post Peak Demand Savings (kW)</i> |
|--------------|------------------------------|------------------------------|-------------------------|---|
| 2010 | 460,642 | 319,911 | 69% | 90.29 |
| 2011 | 332,303 | 251,996 | 76% | 72.24 |
| 2012 | 445,847 | 364,098 | 82% | 202.07 |
| Total | 1,238,791 | 936,005 | 76% | 364.60 |

1.2 Summary of Net Energy and Peak Demand Impacts

ADM estimated program level net-to-gross ratios (NTGRs) using data from self-report surveys and secondary sources. NTGRs are used to adjust gross impact estimates to eliminate savings that would have occurred even in the absence of the program. Net savings may differ from gross savings as a result of free-ridership and spillover. In the context of the Appliance Program, free-ridership refers to participants receiving rebates for purchasing and installing appliances of equal efficiency to what they would have purchased even if a rebate had not been available. Spillover refers to reductions in energy consumption/demand that are caused by the presence of an energy efficiency program, but are not captured in gross savings estimates. For example, a program participant who, because their experience with the Appliance Program, decides to purchase a more efficient air conditioner (without receiving a rebate) would contribute to program spillover.

For the purpose of this evaluation, NTGRs were developed only through the estimation of free ridership. Participant and non-participant survey respondents were asked a series of questions to identify potential program spillover, but those impacts were not quantified, and are likely very small relative to overall program impacts. After accounting for free ridership, the estimated NTGR ratio for the overall Appliance Program is 62%. Multiplying this ratio by gross impacts produces net annual energy savings of 581,985 kWh and a net coincident peak demand reduction of 241.96 kW. Table 4 summarizes the net impacts for the Appliance Program by appliance type for all three program years. Table 5 summarizes net impacts by program year.

Table 4: Net Impact Summary by Appliance Type

| <i>Appliance Type</i> | <i>Gross Ex Post Savings (kWh)</i> | <i>Net Ex Post Savings (kWh)</i> | <i>Net-to-Gross Ratio</i> | <i>Net Ex Post Peak Demand Savings(kW)</i> |
|-----------------------|------------------------------------|----------------------------------|---------------------------|--|
| Dishwashers | 24,125 | 14,476 | 60% | 3.03 |
| Clothes Washers | 661,060 | 398,552 | 60% | 51.29 |
| Room ACs | 197,932 | 135,696 | 69% | 181.76 |
| Refrigerators | 52,887 | 33,261 | 63% | 5.88 |
| Total | 936,005 | 581,985 | 62% | 241.96 |

Table 5: Net Impact Summary by Program Year

| <i>Year</i> | <i>Gross Ex post Savings (kWh)</i> | <i>Net Ex post Savings (kWh)</i> | <i>Net-to-Gross Ratio</i> | <i>Net Ex Post Peak Demand Savings(kW)</i> |
|--------------|------------------------------------|----------------------------------|---------------------------|--|
| 2010 | 319,911 | 196,166 | 61% | 58.87 |
| 2011 | 251,996 | 154,586 | 61% | 47.14 |
| 2012 | 364,098 | 231,233 | 64% | 135.95 |
| Total | 936,005 | 581,985 | 62% | 241.96 |

1.3 Summary of Process Evaluation and Market Characterization Findings

The process evaluation of the Appliance Program was conducted in order to assess the program from a structural and market perspective in order to characterize program context, strengths, and weaknesses. Key process and market related findings and recommendations from the evaluation are summarized below:

Participant Survey Results Summary:

- **Program Awareness:** Results suggest that approximately one-third of participants find out about the program at the time of appliance purchase. Aside from this, participants commonly reported learning of the program through bill inserts from SMUD.
- **Satisfaction:** Overall, participants reported high satisfaction ratings with the program. Instances of dissatisfaction were primarily anecdotal in nature, and the results do not suggest any substantial risks for future customer dissatisfaction.
- **Clothes Washers:** The majority of non-rebated clothes washers owned by program participants are five years old or newer, and are ENERGY STAR® certified. Few participants who did not receive a clothes washer rebate reported that they currently have plans to replace their current clothes washer.
- **Refrigerators:** The majority of non-rebated refrigerators owned by program participants are at least six years old. Most of the participants who own non-rebated refrigerators claim that their current model is ENERGY STAR® certified. Approximately 20% of participants who had not received a refrigerator rebate reported that they are currently planning to replace their refrigerator within two

years. The majority of these respondents indicated that they would be purchasing ENERGY STAR® models.

- **Room Air Conditioners:** Only 14% of program participants who did not receive a room air conditioner rebate through the program reported that they currently own a room air conditioner, and nearly half of these existing units were reported to be ENERGY STAR® certified. Very few respondents indicated that they are currently planning to replace their current room air conditioner.
- **Dishwashers:** The majority of non-rebated dishwashers owned by program participants are six years old or more. The majority of participants who did not receive a dishwasher rebate through the program reported that their current dishwasher is energy efficient. About 10% of participants who had not received a dishwasher rebate reported that they currently have plans to replace their dishwasher, and that it will be an ENERGY STAR® model.

Non-Participant Survey Results Summary:

- **Recent Purchases:** The majority of non-participants had not purchased a qualifying appliance within the past three years. However, the majority of respondents who did report purchasing a qualifying appliance stated that they had purchased an ENERGY STAR® model.
- **Program Awareness:** The majority of non-participants reported being aware of SMUD energy efficiency rebate programs, including the overall Residential Appliance Efficiency Program, and specifically, refrigerator and dishwasher rebates. Respondents who stated that they were aware of these programs most commonly reported that they had learned of them through bill inserts from SMUD.
- **Previous Experience:** Approximately 30% of non-participants reported previously participating in a SMUD energy efficiency program. Most of the respondents who had previously purchased qualifying appliances but had not received a SMUD rebate indicated that they had not been aware of the available rebates at the time of purchase.
- **Likelihood of Future Participation:** Approximately one-quarter of non-participants who reported that they were not previously aware of SMUD programs indicated a likelihood of participating in the Appliance Program next year. The majority of respondents who indicated that they were not likely to participate explained that they were not currently planning to purchase an appliance.
- **Clothes Washers:** Approximately, one-third of clothes washers owned by non-participants are six years old or more, and most are reported to be ENERGY STAR® certified. Very few non-participants reported that they currently have plans to replace their current clothes washer.

- **Refrigerators:** Twenty-seven percent of non-participant refrigerators are at least six years old, and 29% are three to five years old. Approximately half of the refrigerators owned by non-participants are reported to be ENERGY STAR® certified. Very few non-participants reported that they currently have plans to replace their current refrigerator.
- **Room Air Conditioners:** Only 8% of non-participants reported that they currently own a room air conditioner. None of the non-participants indicated that they are currently planning to replace their current room air conditioner.
- **Dishwashers:** Approximately one-third of dishwashers owned by non-participants are reported to be six years old or more. More than half are reported to be ENERGY STAR® certified. Very few non-participants reported that they currently have plans to replace their current dishwasher.

Market Characterization and Potential Summary:

The following summary of the market characterization and potential analysis is based on survey data and the following secondary data sources:

- The California Database for Energy Efficient Resources (DEER);
- ENERGY STAR® Shipment Data;
- US Census Residential Population Data;
- Association of Home Appliance Manufacturers (AHAM) Data; and
- SMUD residential customer population count as of July, 2013 (539,069).

ADM used the results of the program participant and non-participant customer survey to estimate the saturation rate for each appliance type. This included combining results from both program participants who had not received rebates for a given appliance type, and from non-participant homeowners. This resulted in the following estimates:

- **Clothes Washers:**
 - Estimated average number per household: .91
 - Estimated number within the Sacramento region: 490,553
 - Average estimate of ENERGY STAR® clothes washer purchases in Sacramento region within two years: 46,000
- **Refrigerators:**
 - Estimated average number per household: 1.33
 - Estimated number within the Sacramento region: 718,741
 - Average estimate of ENERGY STAR® refrigerator purchases in Sacramento region within two years: 75,000
- **Room Air Conditioners:**

- Estimated average number per household: .13
- Estimated number within the Sacramento region: 71,000
- Final estimate of ENERGY STAR® room air conditioner purchases in Sacramento region within two years: 48,000
- **Dishwashers:**
 - Estimated average number per household: .85
 - Estimated number within the Sacramento region: 457,581
 - Average estimate of ENERGY STAR® dishwasher purchases in Sacramento region within two years: 65,000

Shelf-Level Inventory Summary:

- **Clothes Washers:** Total of 126 models on display, 84% ENERGY STAR® certified.
- **Refrigerators:** Total of 289 models on display, 80% ENERGY STAR® certified.
- **Room Air Conditioners:** Total of five models on display, three of five ENERGY STAR® certified.
- **Dishwashers:** Total of 123 models on display, 98% ENERGY STAR® certified.

Recommendations

The following recommendations are based on the range of evaluation activities conducted for the 2010-2012 program years, including customer surveys, savings verification procedures, program documentation and tracking review, and other tasks.

- **Documentation of Savings Methods:** ADM found that it was sometimes unclear which sources or assumptions were used in determining ex ante program savings. This can cause issues during the evaluation process and can lead to inconsistent savings estimates among measures or between program years. It is recommended that SMUD maintain updated documentation regarding the sources, assumptions, and algorithms used for each calculation, and to ideally provide copies or links to these data sources for future evaluation efforts.
- **Market Penetration Monitoring:** Household appliances are a fast moving market, and energy efficiency levels are increasing with ENERGY STAR® market penetration. The shelf level inventory review shows that many currently-available and popular appliance models are energy efficient. Retail store interviews suggest a substantial portion of customers are seeking energy efficient appliances prior to being aware of available rebates. An annual review of available market data, ENERGY STAR® and CEE standards, and emerging appliance trends is recommended to ensure that SMUD is promoting the most energy efficient options. Thus far, it appears that SMUD has revised program

eligibility and other characteristics in order to stay current with market trends. Continuing this proactive approach to program design will contribute to higher net-to-gross ratios and incremental efficiency gains.

- **Baseline Identification:** Federal and state appliances are subject to change and these changes affect the baseline efficiency assumptions used for gross savings calculations. It is important that there is an awareness regarding these changes and how they affect the program. Upcoming changes for program measures are described in the Gross Impact Evaluation section of this report for all appliance types.

2. Introduction

Under contract with the Sacramento Municipal Utility District (SMUD), ADM Associates, Inc. (ADM) performed evaluation, measurement and verification (EM&V) activities to confirm the energy savings (kWh) and peak demand reductions (kW) being realized through the Residential Appliance Efficiency Program (Appliance Program) that SMUD implemented in 2010, 2011 and 2012. The Appliance Program provides financial incentives to residential customers that purchase ENERGY STAR® and Consortium of Energy Efficiency (CEE) qualified products. The incentives are designed to encourage the purchase and installation of energy-efficient appliances that will help reduce electricity consumption and reduce summer peak load demands. The ENERGY STAR® and CEE-qualified products incentivized in 2010, 2011 and 2012 include:

- Dishwashers
- Clothes Washers
- Room Air Conditioners
- Refrigerators (beginning in 2012)

In addition to verifying gross and net savings, ADM also interviewed participants, non-participating SMUD customers, SMUD staff and local retailers are part of a program evaluation and market characterization study. This report presents the results of these evaluation activities for program years 2010, 2011 and 2012.

Ex ante Savings Review

The first evaluation activity for the Appliance Program was to obtain access to all program materials and tracking databases to review program scope, savings calculations, and data tracking structure. This review informed the development of detailed data collection plans for further primary and secondary data collection activities. ADM documented all ex ante savings assumptions and methodologies, along with areas of uncertainty. Program tracked energy and demand savings were reviewed for each measure included in the program.

Participant Surveys

After reviewing all available program materials and tracking data, ADM developed a sampling plan for surveying program participants via telephone. The goal of the participant surveys was to collect data for analyzing program energy and demand impacts, program attribution for developing net-to-gross ratio estimates, effectiveness of customer program education, and information regarding market penetration and potential. ADM conducted telephone surveys with approximately 220 program participants.

On-Site Verification and Metering

During the participant survey process, a sub-sample of program participants was recruited for on-site verification and metering. For this nested sample, ADM arranged a

time to visit each participant's household to verify that the rebated appliance is installed and operational. In instances where the customer had purchased a clothes washer, ADM asked if they were willing to let us monitor its power consumption for a period of two weeks. This allowed for the verification of the number of wash loads per week. For dishwashers and clothes washers, hot water heater fuel source was also verified (and clothes dryer fuel source in the case of clothes washers).

Non-Participant Surveys

ADM also conducted surveys with SMUD customers who did not participate in the program during 2010, 2011 or 2012. A list of such customers was provided by SMUD and a random sample was called to discuss a number of issues from the non-participant perspective. Non-participants were targeted to provide additional data points for calculating program attribution, market characterization, and market potential. ADM conducted non-participant surveys with 51 SMUD customers.

Shelf-Level Inventory Assessment

To assess one aspect of market penetration and potential, ADM conducted self-level inventories of program rebated appliances at participating retail locations. A sample of retail locations was designed to ensure that all participating retailers were accurately reflected. The shelf-level inventory assessment was conducted by visiting the sampled retail locations and recording make and model numbers, presence of program marketing materials, ENERGY STAR® qualification status, and relevant appliance characteristics. This assessment allowed for determining the percentage of efficient or program eligible appliances that are currently available in retail stores.

Retail Employee Interviews

During the shelf-level inventory process, ADM selected five local appliance retailers, Home Depot, Lowes, Sears, Best Buy and Filco, based upon customer geographic location to visit. During the visit ADM conducted short interviews with retail sales people to assess their understanding of the program and their impression of customer decision making processes. A copy of the questions asked can be found in Appendix A.

Market Scan

ADM conducted multiple research activities to identify key trends and existing characteristics of the energy efficient appliance market. These activities involved online research of market characteristics, interviews with retail store staff, and inventory assessments at retail stores. Specifically, ADM conducted the following activities in an effort to assess the current energy efficient appliance market:

- **Retail Employee Interviews:** Interviews with retail store employees provided information regarding customer preferences, program awareness, and purchasing behaviors. Field staff conducted visits to five appliance retail stores in the SMUD service territory and interviewed one sales employee at each location.

- **Shelf Level Inventory Scan:** ADM field staff visited five participating retail locations throughout the Sacramento area and conducted detailed inventories of all the clothes washers, refrigerators, room air conditioners, and dishwashers on the stores' shelves. These store visits were conducted in early 2014. ADM staff recorded make and model numbers, measure type, and documented the presence of ENERGY STAR® labels. This section summarizes key findings from these retail store visits, including appliance counts and other inventory characteristics.
- **ENERGY STAR® Forecasts:** ADM researched existing shipment data provided on the ENERGY STAR® website in order to assess the extent to which energy efficient appliances have penetrated the market in the past several years. Additionally, ADM reviewed market research studies in order to determine the potential for energy efficiency growth in future years.
- **Future Federal Appliance Standard Changes:** ADM reviewed current standards for appliances rebated through the program and future changes to these standards that will affect the baseline efficiencies for the program.

3. Gross Savings Evaluation

The specific methods used for calculating energy savings and demand reduction associated with each of the program's measures are discussed in this section. Final ex post gross savings estimates per unit and at the program level are also presented. Gross impacts are changes in energy consumption/peak demand that result directly from program-promoted actions regardless of the extent or nature of program influence on these actions. For the Appliance Program, gross impacts represent the difference in energy use between program rebated appliances and minimum efficiency appliances in compliance with federal/state regulations. It is important to point out that, while minimum efficiency appliances exist in the market place, they likely do not represent the baseline efficiency levels that customers would have purchased in the absence of the program. This market baseline issue is addressed in the Net Savings Evaluation section of this report.

3.1 Overview of Methodology

An engineering desk review was conducted for all measures. SMUD provided ADM with tracking data indicating 1) the number of units rebated for each appliance type, by efficiency tier and 2) per-unit ex ante annual kWh savings and coincident peak kW estimates. ADM requested that SMUD provide documentation and source information regarding how the ex ante kWh and kW impacts were developed. However, no exact documentation to this effect was provided, beyond recognition that the estimates were developed from Consortium of Energy Efficiency (CEE) materials. ADM was able to locate a report from the CEE² that did provide impact estimates close (though, not exact) to those provided by SMUD in the program tracking spreadsheet. The CEE report does provide some (though, not all) of the assumptions that result in the per-unit impact estimates, but it does not provide specific algorithms used. The CEE report does make it clear that the ex ante impacts were measured by comparing appliances that meet the CEE efficiency tiers to appliances that only meet federal minimum efficiency requirements.

Using information provided in the CEE report, federal and state efficiency requirements, and algorithms from ENERGY STAR® appliance savings calculators, ADM attempted to recreate the ex ante per-unit impacts that SMUD provided. For the most part, this ex ante savings recreation activity was fairly successful, generating per-unit savings similar to SMUD's ex ante values. In some instances, some uncertainty remains regarding the exact calculation methodologies/assumptions used by SMUD. The assumptions and algorithms used by ADM to calculate ex post savings are detailed by measure type in the sections that follow.

² http://library.cee1.org/sites/default/files/library/9285/2012_SEHA_ID_3.pdf

In addition to annual energy savings, gross coincident peak demand reduction resulting from program rebated appliances are also presented in this section. SMUD defines peak savings as the average load reduction that would occur between 4:00 pm and 7:00 pm during a three-day heat storm that includes the highest annual temperature. The average is measured in kilowatts (kW) across the applicable nine hours. In order to estimate the demand reduction during these hours, ADM used 8,760 normalized load shaped from the California Database for Energy Efficiency Resources (DEER) for the Sacramento region. Annual energy savings were distributed to each hour of the year using the normalized load shapes. For clothes washers, dishwashers, and refrigerators, the average kW reduction during the hours of 4:00 pm – 7:00 pm for the months of July and August were used to estimate the coincident peak demand reduction. For Room air conditioners, the maximum kW for the hours of 4:00 pm – 7:00 pm in July and August were used in order to represent the likely room air conditioner usage during a three-day heat wave.

3.2 Summary of Gross Program Impacts

A summary of gross impacts estimated through this evaluation is presented in Table 6 by appliance type. Ex post annual energy savings for the Appliance Program from 2010 – 2012 are 936,005 kWh, representing a realization rate of 76%. Ex post gross peak demand reduction is estimated at 364.6 kW.

Table 6: Gross Impact Summary by Appliance Type

| <i>Appliance Type</i> | <i>Ex Ante Savings (kWh)</i> | <i>Ex Post Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex Post Peak Demand Savings (kW)</i> |
|-----------------------|------------------------------|------------------------------|-------------------------|---|
| Dishwashers | 74,632 | 24,125 | 32% | 5.06 |
| Clothes Washers | 840,157 | 661,060 | 79% | 85.06 |
| Room ACs | 300,670 | 197,932 | 66% | 265.12 |
| Refrigerators | 23,332 | 52,887 | 227% | 9.35 |
| Total | 1,238,791 | 936,005 | 76% | 364.60 |

Table 7 summarizes the gross energy and demand impacts of the Appliance Program by program year.

Table 7: Gross Impact Summary by Program Year

| <i>Year</i> | <i>Ex Ante Savings (kWh)</i> | <i>Ex Post Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex Post Peak Demand Savings (kW)</i> |
|--------------|------------------------------|------------------------------|-------------------------|---|
| 2010 | 460,642 | 319,911 | 69% | 90.29 |
| 2011 | 332,303 | 251,996 | 76% | 72.24 |
| 2012 | 445,847 | 364,098 | 82% | 202.07 |
| Total | 1,238,791 | 936,005 | 76% | 364.60 |

In the sections that follow, the details of the ex post savings estimation methodology and assumptions are provided for each measure.

3.3 Dishwashers

The energy savings attributable to the installation of an efficient dishwasher as opposed to a standard dishwasher depend on a number of parameters. Specific parameters that influence energy usage include:

- Average number of cycles per year
- Hot water fuel type
- Baseline dishwasher characteristics
- Average program eligible dishwasher characteristics

For baseline efficiency dishwashers, the federal and California appliance efficiency regulations require that each standard capacity dishwasher has a maximum energy use of 355 kWh per year with a maximum water usage of 6.5 gallons per cycle. This standard was set as part of the Energy Independence and Security Act (EISA) in 2007. It became effective January 1, 2010, which happens to be the same date that the first program year evaluated for this report started. As such, ex post gross savings are evaluated relative to this baseline for all three program years (2010, 2011, 2012).

That said, the ex ante gross savings appear to be calculated relative to a different, older baseline. Prior to the EISA standards that went into effect in 2010, the last update to federal standards occurred in 1994, and set the minimum energy factor (EF) for standard capacity dishwashers at 0.46. The EF represents cycles per kWh for a given dishwasher. Thus, a higher EF indicates a more efficient unit. Dishwashers are tested under Department of Energy (DOE) test procedures to determine model specific energy factors. Annual kWh usage is then extrapolated under the assumption of 215 cycles per year (about four cycles per week). Table 8 below shows the annual kWh usage of dishwashers with different energy factors, under the 215 cycle per year assumption.

Table 8: Comparison of Annual kWh Usage at Different Energy Factors³

| | <i>1994 Federal Minimum</i> | <i>Apparent Ex Ante Baseline</i> | <i>2010 Federal Minimum</i> | <i>2011 CEE Tier 1</i> | <i>2011 CEE Tier 2</i> | <i>2012 CEE Tier 1</i> |
|---|---------------------------------|--|-------------------------------------|----------------------------|----------------------------|----------------------------|
| <i>Metric</i> | <i>EF = 0.46</i> | <i>EF = 0.50</i> | <i>EF = NA</i> | <i>EF = 0.65</i> | <i>EF = 0.68</i> | <i>EF = 0.75</i> |
| Annual kWh | 467.39 | 430.00 | 355.00 | 330.77 | 316.18 | 286.67 |
| kWh Savings Relative to Ex Ante Baseline | N/A | N/A | N/A | 99.23 | 113.82 | 143.33 |
| kWh Savings Relative to 2010 Federal Standard | N/A | N/A | N/A | 24.23 | 38.82 | 68.33 |

As the table above shows, kWh savings relative to the 2010 federal minimum efficiency savings are much lower than those used for ex ante estimates. For this reason, dishwashers have a relatively low realization rate when comparing ex post to ex ante savings estimates.

In addition to considering different baseline efficiencies, there is one other less significant difference between ex ante and ex post. Ex ante estimates appear to be calculated under the standard assumption of 215 cycles per year (4.12 cycles per week). As part of the participant survey, respondents were asked to estimate approximately how many times they use their dishwasher in a week. On average, customers reported running 3.44 cycles per week (179 cycles per year). This value was used for ex post calculations.

Over 50% of the energy usage from dishwashers is the result of water heating. Because SMUD is an electric only utility, rebates for dishwashers are restricted to customers who have electric hot water heating in their homes. During the participant survey, customers who indicated they received a rebate for a dishwasher were asked what type of water heater they have in their homes. Of 61 respondents, 56 reported having electric hot water heaters, three indicated they were unsure, and two said they have natural gas water heaters. Because the percentage of respondents indicating natural gas water heaters is within the margin of error for the survey, no adjustments were made to ex post savings as a result of this finding. Still, it is worth mentioning so that SMUD is aware there may be a small percentage of dishwasher rebates incorrectly being paid to customers with non-electric water heating.

Table 9 presents ex post dishwasher gross impacts by efficiency level:

³ These calculations do not account for standby energy usage, which is generally < 20 kWh annually.

Table 9: Dishwasher kWh and kW savings

| <i>Efficiency Level</i> | <i>Ex ante per Unit Savings (kWh)</i> | <i>Ex post Per Unit Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex post Per Unit Demand Savings (kW)</i> | <i>Units Rebated</i> | <i>Total kWh Savings</i> | <i>Total kW Savings</i> |
|-------------------------|---------------------------------------|---------------------------------------|-------------------------|---|----------------------|--------------------------|-------------------------|
| 2011 Tier 1 (EF 0.65) | 96.46 | 20.17 | 21% | 0.004 | 184 | 3,712 | 0.78 |
| 2011 Tier 2 (EF 0.68) | 110.24 | 32.32 | 29% | 0.007 | 364 | 11,766 | 2.47 |
| 2012 Tier 1 (EF 0.75) | 110.24 | 56.89 | 52% | 0.012 | 152 | 8,648 | 1.81 |
| Total | | | | | 700 | 24,125 | 5.06 |

Table 10 presents gross impacts for dishwashers by year:

Table 10: Dishwasher kWh and kW savings by year

| <i>Year</i> | <i>Ex ante Savings (kWh)</i> | <i>Ex post Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex post Demand Savings (kW)</i> |
|---------------|------------------------------|------------------------------|-------------------------|------------------------------------|
| 2010 | 28,097.42 | 7,386.84 | 26% | 1.55 |
| 2011 | 26,595.40 | 7,165.39 | 27% | 1.50 |
| 2012 | 19,939.66 | 9,572.72 | 48% | 2.01 |
| Totals | 74,632.48 | 24,124.95 | 32% | 5.06 |

Table 11 presents the gross water savings resulting from rebated dishwashers as compared to standard efficiency units. The CEE 2012 Tier 1 was the only tier that had a water factor qualification requirement. Specifically, to meet the 2012 Tier one units needed to use a maximum of 4.25 gallons of water per load. This was compared to the federally allowed maximum of 6.5 gallons per load.

Table 11: Dishwasher Gross Water Savings

| <i>Federal Maximum</i> | <i>2012 CEE Tier 1 Maximum</i> | <i>Estimated Annual Cycles</i> | <i>Number of units</i> | <i>Gross Water Savings (Annual Gallons)</i> |
|------------------------|--------------------------------|--------------------------------|------------------------|---|
| 6.5 gal./cycle | 4.25 gal./cycle | 179 | 152 | 61,218 |

It is worth noting that, in 2013 the federal energy conservation standards for standard capacity dishwashers have been amended. For standard capacity dishwashers manufactured after January 1, 2013, the maximum annual energy usage is 307 kWh. Maximum water consumption is 5.0 gallons per cycle. SMUD should consider these standards as baseline dishwasher efficiency for the 2013 program year and moving forward. This will greatly diminish the savings attributable to current CEE Tier 1 dishwashers. It may be in SMUD's interest to consider a higher efficiency threshold for dishwashers.

3.4 Clothes Washers

Our analysis of savings resulting from the purchase and installation of efficient clothes washers focused on identifying the following inputs to savings calculations:

- Average unit capacity
- Cycles per year
- Relative percentages of dryer fuel sources
- Relative percentage of water heater fuel sources
- Average Modified Energy Factor (MEF) of eligible units
- Average Water Factor (WF) of eligible units

All energy savings calculations were performed using baseline energy usage from a standard unit compliant with the California Appliance Efficiency Regulations. Specifically, the energy efficiency standards shown in Table 12 were used to define baseline energy usage.

Table 12: Baseline Energy Efficiency Standards for Clothes Washers⁴

| Appliance | Minimum Modified Energy Factor Effective January 1, 2007 | Maximum Water Factor Effective January 1, 2011 |
|--------------------------------------|---|---|
| Top-loading compact clothes washers | 0.65 | -- |
| Top-loading standard clothes washers | 1.26 | 9.5 |
| Top-loading, semi-automatic | N/A ¹ | -- |
| Front-loading clothes washers | 1.26 | 9.5 |
| Suds-saving | N/A ¹ | -- |

¹ Must have an unheated rinse water option.

The two clothes washer metrics that are used to define energy usage are the Modified Energy Factor (MEF) and the Water Factor (WF). The MEF of a clothes washer refers to the quotient of the capacity (ft³) of the clothes container divided by the total energy consumption per cycle. The total energy consumption per cycle is expressed as the sum of the machine electrical energy consumption, the hot water energy consumption, and the energy required for removal of the remaining moisture in the wash load. These energy requirements are determined through clothes washer DOE test procedures.⁵ The WF of a clothes washer refers to the quotient of the total weighted per-cycle water consumption divided by the capacity (ft³) of the clothes washer, as determined through the applicable DOE test procedure.

⁴ Taken directly from: <http://www.energy.ca.gov/2012publications/CEC-400-2012-019/CEC-400-2012-019-CMF.pdf>

⁵ The DOE test procedure for residential clothes washers is defined in 10 CFR Section 430.23(j) (Appendix J1 to Subpart B of Part 430) (2008). Available at: <http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-23.pdf>

Because the tracking data provided by SMUD does not include model specific information such as capacity, MEF, or WF, some assumptions were necessary. For MEF and WF, the baseline standards were compared to minimum qualification requirements for each CEE tier, shown in Table 13.

Table 13: CEE Tier MEF and WF Qualification Levels

| <i>Level</i> | <i>Modified Energy Factor (MEF)</i> | <i>Water Factor (WF)</i> |
|-------------------|-------------------------------------|--------------------------|
| Baseline Standard | 1.26 | 9.5 |
| CEE Tier 1 (2010) | 1.8 | 7.5 |
| CEE Tier 2 (2010) | 2.0 | 6 |
| CEE Tier 3 (2010) | 2.2 | 4.5 |
| CEE Tier 1 (2011) | 2.0 | 6 |
| CEE Tier 2 (2011) | 2.2 | 4.5 |
| CEE Tier 3 (2011) | 2.4 | 4 |

As shown in Table 13, the CEE Tier qualification criteria were changed in 2011. SMUD's ex ante savings values were based on the specification that was active in 2010 (the specification was first effective in 2007). ADM calculated savings based on the active CEE specification for each program year. Different efficiency levels were considered for the 2011 and 2012 program year as compared to 2010.

For average capacity, ADM assumed a tub volume of 3.54 cubic feet, based on the existing stock of close washers in the California Energy Commission (CEC) database as of September, 2013.⁶ ADM recommends that SMUD track these characteristics (MEF, WF, capacity) for units rebated in future program years in order to develop program specific estimates.

Water heating fuel source and dryer fuel source are important inputs to electrical savings calculations, as most of the energy savings attributable to high efficiency clothes washers result from water heating savings and dryer savings (high efficiency units remove more moisture during the spin cycle, reducing the energy usage required to dry clothes). It is a program requirement that customer homes have electric water heating to receive a rebate. As part of the participant survey, ADM asked customers who received clothes washer rebates to provide their water heating and dryer fuel sources. These results for these questions are provided in Table 14 below.

⁶ The analysis of the CEC database comes from the Northwest Power and Conservation Council Regional Technical Forum, and is available at: <http://rtf.nwcouncil.org/measures/measure.asp?id=118>

Table 14: Fuel Source Combinations from Participant Survey

| Fuel Source Combination | Number of Responses | Percentage of Responses |
|---------------------------------------|---------------------|-------------------------|
| Gas water heater, gas dryer | 8 | 5% |
| Gas water heater, electric dryer | 5 | 3% |
| Electric water heater, gas dryer | 16 | 9% |
| Electric water heater, electric dryer | 142 | 83% |
| Total | 171 | 100% |

As expected, Table 14 shows that the vast majority of program participants who purchased clothes washers have electric water heating and electric dryers. However, a small percentage of respondents indicated they have gas water heating, in contradiction to program requirements. Nine percent of respondents indicated that while they have electric water heating, they have a natural gas dryer.

ADM also asked customers to estimate their total number of wash loads per week. For five survey respondents, follow up on-site visits were performed and monitoring equipment was installed on the rebated clothes washers to identify the number of cycles per week (201 loads per year). The average number of loads per week for the five clothes washers that were monitored in-situ was 4.45 (232 loads per week). Both of these estimates for clothes washer usage are lower than most studies, where estimates range from approximately 250 to 400 loads per year for single family homes. Given the small sample size for monitored data, and the fact that customer self-report surveys may underestimate clothes washer usage, ADM decided to assume 300 loads per year, which is a typical assumption and within the range of usual estimates.

Ex post gross annual energy savings were calculated as:

$$kWh \text{ Savings} = [((CAPY_{base} / MEF_{base}) \times (CW_{base} + (DHW_{base} \times \%Electric \text{ DHW}) + (Dryer_{base} \times \%Electric \text{ Dryer}))) - ((CAPY_{EE} / MEF_{EE}) \times (CW_{EE} + (DHW_{EE} \times \%Electric \text{ DHW}) + (Dryer_{EE} \times \%Electric \text{ Dryer})))] \times Cycles$$

Where:

$$CAPY_{base} \text{ and } CAPY_{EE} = 3.54$$

$$MEF_{base} = 1.26$$

$$MEF_{EE} = 2.0 \text{ (Tier 1), } 2.2 \text{ (Tier 2), or } 2.4 \text{ (Tier 3)}$$

$$Cycles = \text{annual cycles (300)}$$

$$CW_{base} \text{ and } CW_{EE} = \text{Percent of total energy consumption from CW machine operation (9\%)}$$

$$DHW_{base} \text{ and } DHW_{EE} = \text{Percent of total energy consumption from water heating (37\% for base, 22\% for EE)}$$

$$Dryer_{base} \text{ and } Dryer_{EE} = \text{Percent of total energy consumption for removing remaining moisture (54\% base, 69\% EE)}$$

Table 15 presents gross impacts resulting from rebated clothes washers by efficiency level:

Table 15: Clothes washer kWh and kW savings by efficiency level

| Efficiency Level | Ex ante per Unit Savings (kWh) | Ex post per Unit Savings (kWh) | Realization Rate | Ex post per Unit Demand Savings (kW) | Units Rebated | Total kWh Savings | Total kW Savings |
|------------------|--------------------------------|--------------------------------|------------------|--------------------------------------|---------------|-------------------|------------------|
| Tier 1 (2010) | 293 | 207 | 71% | 0.038 | 62 | 12,843 | 1.65 |
| Tier 2 (2010) | 361 | 262 | 73% | 0.046 | 50 | 13,092 | 1.68 |
| Tier 3 (2010) | 417 | 307 | 74% | 0.054 | 804 | 246,509 | 31.72 |
| Tier 1 (2011) | 293 | 262 | 89% | 0.038 | 29 | 7,594 | 0.98 |
| Tier 2 (2011) | 361 | 307 | 85% | 0.046 | 102 | 31,274 | 4.02 |
| Tier 3 (2011) | 417 | 344 | 82% | 0.054 | 1,017 | 349,749 | 45.01 |
| Total | | | | | 2,064 | 661,060 | 85.06 |

Table 16 presents gross impacts for clothes washers by year:

Table 16: Clothes Washer kWh and kW savings by year

| Year | Ex ante Savings (kWh) | Ex post Savings (kWh) | Realization Rate | Ex post Demand Savings (kW) |
|--------------|-----------------------|-----------------------|------------------|-----------------------------|
| 2010 | 371,142 | 272,444 | 73% | 35.06 |
| 2011 | 256,255 | 212,428 | 83% | 27.34 |
| 2012 | 212,760 | 176,188 | 83% | 22.67 |
| Total | 840,157 | 661,060 | 79% | 85.06 |

The realization rate reflects the fact that a small percentage of program participants did not have electric water heating and/or electric dryers. It also reflects the fact that SMUD's ex ante savings for all three program years were based on the CEE specification in effect in 2010, and were not updated when the CEE specification changed in January 2011. It also appears that SMUD's ex ante savings were based on the assumption of 400 cycles per year, whereas ADM's ex post estimations assume 300 cycles per year.

Table 17 presents the gross water savings resulting from rebated clothes washers as compared to standard efficiency units. The various CEE Tiers require certain water efficiency levels in order for a unit to qualify. This was compared to the federally allowed maximum of 9.5 gallons per load.

Table 17: Clothes Washer Gross Water Savings

| CEE Tier level | Federal Maximum WF | CEE Tier Maximum WF | Estimated Annual Cycles | Estimated Cubic Feet of Laundry / Cycle | Number of units | Gross Water Savings (Annual Gallons) |
|----------------|--------------------|---------------------|-------------------------|---|-----------------|--------------------------------------|
| Tier 1 (2010) | 9.5 | 7.5 | 300 | 3 | 62 | 111,600 |
| Tier 2 (2010) | 9.5 | 6.0 | 300 | 3 | 50 | 157,500 |
| Tier 3 (2010) | 9.5 | 4.5 | 300 | 3 | 804 | 3,618,000 |
| Tier 1 (2011) | 9.5 | 6.0 | 300 | 3 | 29 | 91,350 |
| Tier 2 (2011) | 9.5 | 4.5 | 300 | 3 | 102 | 459,000 |
| Tier 3 (2011) | 9.5 | 4.0 | 300 | 3 | 1,017 | 5,034,150 |
| Total | | | | | 2,064 | 9,471,600 |

New residential clothes washer standards were adopted in 2012 by DOE that are set to take effect in March of 2015. The new standards are based on new metrics called integrated modified energy factor (IMEF) and integrated water factor (IWF). These metrics take into account the standby and off mode energy consumption of clothes washers. Starting March 2015, the federal standards will require an IMEF of 1.29 (correlates to 1.72 MEF) and an IWF of 8.4 (correlates to a WF of 8.0) for top-loading clothes washers. Similarly, front-loading clothes washers will require an IMEF of 1.84 (correlates to an MEF of 2.2) and an IWF of 4.7 (correlates to a WF of 4.5). SMUD should be aware of these new standards when determining qualification and incentive levels for future program years.

3.5 Room Air Conditioners

Energy savings resulting from the installation of efficient room air conditioners are assessed in relation to baseline efficiency units. The baseline efficiency for all room air conditioners was determined based on the California Appliance Efficiency Regulations. Specifically, minimum EER requirements by capacity and type are shown in Table 18 below.

Table 18: CA Standards for Room Air Conditioners⁷

| Appliance | Louvered Sides | Cooling Capacity (Btu/hr) | Minimum EER |
|----------------------|----------------|---------------------------|-------------|
| Room Air Conditioner | Yes | < 6,000 | 9.7 |
| Room Air Conditioner | Yes | ≥ 6,000 – 7,999 | 9.7 |
| Room Air Conditioner | Yes | ≥ 8,000 – 13,999 | 9.8 |
| Room Air Conditioner | Yes | ≥ 14,000 – 19,999 | 9.7 |
| Room Air Conditioner | Yes | ≥ 20,000 | 8.5 |
| Room Air Conditioner | No | < 6,000 | 9.0 |
| Room Air Conditioner | No | ≥ 6,000 – 7,999 | 9.0 |
| Room Air Conditioner | No | ≥ 8,000 – 19,999 | 8.5 |
| Room Air Conditioner | No | ≥ 20,000 | 8.5 |

⁷Taken directly from: <http://www.energy.ca.gov/2012publications/CEC-400-2012-019/CEC-400-2012-019-CMF.pdf>

Data regarding average capacity, EER, and presence of louvered sides⁸ for program rebated room air conditioners was not available in the tracking data provided by SMUD. Additionally, the list of participant customers did not identify which customers were rebated for room air conditioners, as opposed to other appliances. For this reason, determining program specific values was difficult with the available data. Instead, ADM relied on ENERGY STAR® assumptions regarding capacity, and CEE tier minimum EER requirements. Effective Full Load Hours (EFLHs) for room air conditioners in the Sacramento area were also taken from the ENERGY STAR® room air conditioner calculator⁹ (EFLHs = 871). Ex post annual energy savings are calculated as:

$$\text{Annual kWh Savings} = \frac{EFLH * \left(\frac{CAPY_{base}}{EER_{base}}\right)}{1000} - \left(\frac{EFLH * \left(\frac{CAPY_{efficient}}{EER_{efficient}}\right)}{1000}\right)$$

Where:

EFLH = 871

CAPY_{base} and CAPY_{efficient} = 10,000 Btu

EER_{base} = 9.8

EER_{efficient} = 11.3 (Tier 1) or 11.8 (Tier 2)

It should be noted, that the ex ante annual savings calculations are based on the same algorithm, but averaged across four room air conditioner capacity bins (<8,000 Btu, 8,000-13,999 Btu, 14,000 – 19,999 Btu, and >19,999 Btu). By averaging across these capacity ranges, the ex ante estimates implicitly give more weight to high capacity units than is reasonable for the distribution of units purchased through the program. Again, capacity data for program specific units was not available, but a number of sources suggest that the average capacity of purchased room air conditioners is likely on the lower end of the range. The Association of Home Appliance Manufacturers (AHAM) released shipment weighted average capacity for units shipped in 2010. This average was just 8,737 Btu.¹⁰ The ENERGY STAR® room air conditioner calculator assumes an average room air conditioner capacity of 10,000 Btu, which they attribute to the typical room air conditioner size in April, 2009. ADM likewise chose 10,000 Btu for ex post estimates. ADM recommends that SMUD track capacity data for room air conditioners purchased through the program in future years, so a more specific SMUD service territory estimate of capacity can be developed.

⁸ Room air conditioners without louvered sides are also referred to as “through the wall” or “built-in” units.

⁹ http://www.energystar.gov/buildings/sites/default/uploads/files/RoomAC_Calculator.xls?b882-aad4

¹⁰ <http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=5.7.7>

Table 19 presents gross impacts for room air conditioners by efficiency level. The main reason the ex post per-unit impacts are lower than the ex ante estimates is the difference in capacity assumptions, discussed above.

Table 19: Room air conditioner kWh and kW savings by efficiency level

| Efficiency Level | Ex ante per Unit Savings (kWh) | Ex post Savings (kWh) | Realization Rate | Ex post Demand Savings (kW) | Units Rebated | Total kWh Savings | Total kW Savings |
|------------------|--------------------------------|-----------------------|------------------|-----------------------------|---------------|-------------------|------------------|
| Tier 1 | 202 | 118 | 58% | 0.16 | 51 | 6,017 | 8.06 |
| Tier 2 | 228 | 151 | 66% | 0.20 | 1,274 | 191,915 | 257.06 |
| Total | | | | | 1,325 | 197,932 | 265.12 |

Table 20 presents gross impacts for room air conditioners by year. The high realization rates are due to a calculation error in the program tracking spreadsheet that did not account for the energy savings of most units rebated. Specifically, the spreadsheet did not correctly sum over all months within each program year. As a result, the only energy and demand impacts that were reported for room air conditioners were from units purchased in January of each year. Accounting for room air conditioners rebated in February-December of each year significantly increases impacts associated with this measure. Thus, the extremely high realization rates, despite per-unit savings estimates lower than the ex ante assumptions.

Table 20: Room air conditioner kWh and kW savings by year

| Year | Ex ante Savings (kWh) | Ex post Savings (kWh) | Realization Rate | Ex post Demand Savings (kW) |
|--------------|-----------------------|-----------------------|------------------|-----------------------------|
| 2010 | 456 | 40,080 | 8793% | 53.69 |
| 2011 | 1,317 | 32,402 | 2461% | 43.40 |
| 2012 | 684 | 125,450 | 18349% | 168.04 |
| Total | 2,456 | 197,932 | 8059% | 265.12 |

For the purpose of comparing “apples-to-apples,” ADM considered the corrected ex ante values to be the official values which realization rates are based. That is, the program level impacts for room air conditioners had the tracking spreadsheet correctly summed over all months of participation. Table 21 presents the evaluation results under the condition that these additional units were correctly accounted for in the ex ante impact estimates.

Table 21: Room air conditioner kWh and kW savings by year

| Year | Corrected Ex ante Savings (kWh) | Ex post Savings (kWh) | Realization Rate | Ex post Demand Savings (kW) |
|--------------|---------------------------------|-----------------------|------------------|-----------------------------|
| 2010 | 61,403 | 40,080 | 65% | 53.69 |
| 2011 | 49,452 | 32,402 | 66% | 43.40 |
| 2012 | 189,815 | 125,450 | 66% | 168.04 |
| Total | 300,670 | 197,932 | 66% | 265.12 |

It is worth pointing out that the federal minimum efficiency standards for room air conditioners were revised in 2011 with new standards set to take effect in 2014. The new standards are based on a new metric, combined energy efficiency ratio (CEER), which incorporates standby energy consumption.¹¹ SMUD should be aware of these revisions when designing qualification and incentive levels for the 2014 program year.

3.6 Refrigerators

In 2012, SMUD added energy efficient refrigerators to the Appliance Program. Estimates of the gross energy savings resulting from the purchase and installation of efficient refrigerators were calculated in reference to baseline refrigerator energy usage as described in the California Appliance Efficiency Regulations. Maximum energy consumption (kWh/yr) regulations for various refrigerator types manufactured after 2001 are shown in Table 22 below.

¹¹ Specifics regarding the new standard can be found at:
<http://www.regulations.gov/#!documentDetail;D=EERE-2013-BT-STD-0020-0004>

Table 22: California Appliance Efficiency Regulations for Refrigerators – Maximum Energy Consumption¹²

| <i>Appliance</i> | <i>Maximum Energy Consumption (kWh/yr)</i> |
|---|--|
| Refrigerators and Refrigerator-Freezers with manual defrost | 8.82AV + 248.4 |
| Refrigerator-Freezer – partial automatic defrost | 8.82AV + 248.4 |
| Refrigerator-Freezers – automatic defrost with top-mounted freezer without through-the-door ice service and all refrigerators – automatic defrost | 9.80AV + 276.0 |
| Refrigerator-Freezers – automatic defrost with side-mounted freezer without through-the-door ice service | 4.91 AV + 507.5 |
| Refrigerator-Freezers – automatic defrost with bottom-mounted freezer | 4.60AV + 459.0 |
| Refrigerator-Freezers – automatic defrost with top-mounted freezer with through-the-door ice service | 10.20AV + 356.0 |
| Refrigerator-Freezers – automatic defrost with side-mounted freezer with through-the-door ice service | 10.10AV + 406.0 |
| Upright Freezers with manual defrost | 7.55AV + 258.3 |
| Upright Freezers with automatic defrost | 12.43AV + 326.1 |
| Chest Freezers and all other Freezers except Compact Freezers | 9.88AV + 143.7 |
| Compact Refrigerators and Refrigerator-Freezers with manual defrost | 10.70AV + 299.0 |
| Compact Refrigerator-Freezers – partial automatic defrost | 7.00AV + 398.0 |
| Compact Refrigerator-Freezers – automatic defrost with top-mounted freezer and compact all refrigerators – automatic defrost | 12.70AV + 355.0 |
| Compact Refrigerator-Freezers – automatic defrost with side-mounted freezer | 7.60AV + 501.0 |
| Compact Refrigerator-Freezers – automatic defrost with bottom-mounted freezer | 13.10AV + 367.0 |
| Compact Upright Freezers with manual defrost | 9.78AV + 250.8 |
| Compact Upright Freezers with automatic defrost | 11.40AV + 391.0 |
| Compact Chest Freezers | 10.45AV + 152.0 |
| AV = adjusted total volume, expressed in ft ³ , as determined in 10 CFR, Part 430, Appendices A1 and B1 of Subpart B (2008), which is: [1.44 x freezer volume (ft ³)] + refrigerator volume (ft ³) for refrigerators; [1.63 x freezer volume (ft ³)] + refrigerator volume (ft ³) for refrigerator-freezers; [1.73 x freezer volume (ft ³)] for freezers. | |
| Note: Maximum energy consumption standards for refrigerator-freezers with internal freezers are same as those for refrigerator-freezers with top-mounted freezers. | |

Again, the program tracking data provided to ADM did not provide model specific information such as refrigerator configuration, refrigerator size, presence of a through-the-door ice maker, or defrost type. ADM recommends that these characteristics, along with make and model number, are tracked in future program years. Without these program specific characteristics, assumptions were required to estimate baseline and measure level energy usage.

For refrigerator configuration, ADM asked participant survey respondents to identify the type of refrigerator they purchased. Table 23 shows the results of this question.

¹² Taken directly from: <http://www.energy.ca.gov/2012publications/CEC-400-2012-019/CEC-400-2012-019-CMF.pdf>

Table 23: Type of Refrigerators Rebated

| | Response | (n=88) | Percent of Respondents |
|---|-----------------------------|--------|------------------------|
| What kind of refrigerator model did you purchase? | Top-freezer refrigerator | 19 | 22% |
| | Bottom-freezer refrigerator | 41 | 47% |
| | Side-by-Side refrigerator | 26 | 30% |
| | DK | 1 | 1% |
| | RF | 1 | 1% |

Based on the survey responses shown in the table above, ADM assumed that 22% of rebated refrigerators were top freezer models, 47% were bottom-freezer models, and 30% were side-by-side models. The participant survey did not try to ascertain refrigerator capacities, ice maker presence, or defrost types as these characteristics are generally not easy for survey respondents to identify. Instead, ADM used ENERGY STAR® assumptions regarding capacity, ice maker presence, and defrost type. Specifically, it was assumed that all rebated units have automatic defrost, 95% of side-by-side units have through-the-door ice service, 31% of bottom freezer units have through-the-door ice service, and no top freezer units have through-the-door ice service.¹³

Based on these assumptions, the baseline (federal minimum) energy use and CEE Tier 3 energy use are shown in Table 24 below.¹⁴

Table 24: Estimated Annual kWh for Refrigerators

| Configuration | Estimated Percentage of Rebated Units | kWh Baseline | kWh CEE Tier 3 |
|-----------------------------|---------------------------------------|--------------|----------------|
| Top-freezer refrigerator | 22% | 486.2 | 340.3 |
| Bottom-freezer refrigerator | 48% | 606.5 | 424.5 |
| Side-by-Side refrigerator | 30% | 934.7 | 654.3 |
| Weighted Usage | 100% | 679.1 | 475.4 |
| Annual kWh Savings | N/A | N/A | 203.7 |

Interestingly, it appears that SMUD's ex ante gross savings were not calculated by comparing federal minimum baseline efficiency to measure level efficiency, as was the case with other program measures. Instead, it appears that SMUD incorporated ENERGY STAR® refrigerator market penetration for 2011 (56%) into their calculations for refrigerator impacts. The fact that refrigerators were added to the program in 2012 while ex ante savings for other measures were developed pre-2010 may explain this discrepancy. For the purpose of consistency, ADM's ex post annual energy savings

¹³ The percentage of units with through-the-door ice service was based on an analysis of current ENERGY STAR® qualified product lists.

¹⁴ SMUD only rebated refrigerators that met CEE Tier 3 qualifications in 2012.

were calculated as the difference between estimated CEE Tier energy usage and baseline (federal minimum) unit energy usage. As a result, ex post gross savings are considerably higher than SMUD's ex ante estimate. However, these differences are accounted for in the Net Savings Evaluation of this report. Table 25 presents gross impacts for rebated refrigerators by efficiency level.

Table 25: Refrigerator kWh and kW savings by efficiency level

| <i>Efficiency Level</i> | <i>Ex Ante per Unit Savings (kWh)</i> | <i>Ex post per Unit Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex post Demand Savings (kW)</i> | <i>Units Rebated</i> | <i>Total kWh Savings</i> | <i>Total kW Savings</i> |
|-------------------------|---------------------------------------|---------------------------------------|-------------------------|------------------------------------|----------------------|--------------------------|-------------------------|
| Tier 3 ($\geq 30\%$) | 92.22 | 209.04 | 227% | 0.04 | 253 | 52,887 | 9.35 |
| Total | | | | | 253 | 52,887 | 9.35 |

Table 26 presents gross impacts for refrigerators by year:

Table 26: Refrigerator kWh and kW savings by year

| <i>Year</i> | <i>Ex ante Savings (kWh)</i> | <i>Ex post Savings (kWh)</i> | <i>Realization Rate</i> | <i>Ex post Demand Savings (kW)</i> |
|--------------|------------------------------|------------------------------|-------------------------|------------------------------------|
| 2012 | 23,331.66 | 52,887.46 | 227% | 9.35 |
| Total | 23,331.66 | 52,887.46 | 227% | 9.35 |

4. Net Savings Evaluation

This chapter reports the results from estimating the net impacts of the Residential Appliance Efficiency Program during 2010, 2011 and 2012.

4.1 Procedures Used To Estimate Net Savings

Net savings are defined as the portion of gross savings that can be directly attributed to the effects of the program. Net savings may differ from gross savings as a result of free-ridership and spillover. In the context of the Appliance Program, free-ridership refers to participants receiving rebates for purchasing and installing appliances of equal efficiency to what they would have purchased even if a rebate had not been available. Spillover refers to reductions in energy consumption/demand that are caused by the presence of an energy efficiency program, but are not captured in gross savings estimates. For example, a program participant who, because their experience with the Appliance Program, decides to purchase a more efficient air conditioner (without receiving a rebate) would contribute to program spillover.

For the purpose of this evaluation, NTGRs were developed only through the estimation of free ridership. Participant and non-participant survey respondents were asked a series of questions to identify potential program spillover, but those impacts were not quantified, and are likely very small relative to overall program impacts. A qualitative discussion of potential spillover is presented in the last section of this chapter.

ADM's methodology for estimating net-to-gross ratios is an adaptation of the methodology that we have applied in deriving estimates of free-ridership and net-to-gross ratios in previous evaluations of other downstream appliance rebate programs. The approach relies on (1) developing actual market efficiency level baselines for each of the program incentivized appliances and (2) using participant and non-participant self-reported data to assess the likelihood that customers would select efficient home appliances in the absence of program sponsored rebates. ADM then compared the results of the two net saving methodologies and used the preponderance of evidence to estimate net impacts.

4.2 Market Efficiency Level Estimation

Gross impacts attributable to the program have been estimated as the difference between federal/state appliance regulations and the specific CEE Tier qualifications. However, the federal/state minimum efficiencies do not necessarily reflect the efficiency levels that customers would have purchased in the absence of the program. Technological advances, national energy efficiency initiatives including ENERGY STAR®, and numerous utility sponsored appliance rebate programs have all contributed to driving market efficiency levels above the federal/state minimums. In order to estimate more accurate baseline efficiencies, ADM relied on ENERGY STAR® market penetration sales/shipment data for 2009, 2010, and 2011. As shown in Figure 1,

national ENERGY STAR® market penetration was relatively high during the three program years.

Figure 1: ENERGY STAR® Market Penetration 2009-2012¹⁵

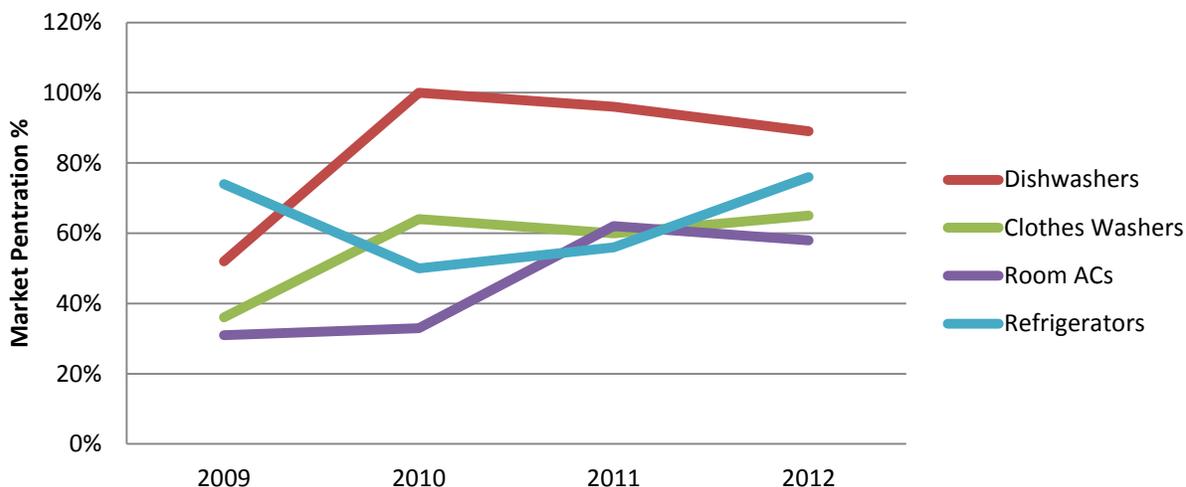


Table 27 below shows which ENERGY STAR® specification was active for each program year and each appliance type.

Table 27: ENERGY STAR® Specification in Effect by Program Year

| Year | Dishwashers | Clothes Washers | Room ACs | Refrigerators |
|------|-------------|-----------------|-------------|---------------|
| 2009 | Version 4.0 | Version 5.1 | Version 2.1 | Version 4.1 |
| 2010 | Version 4.0 | Version 5.1 | Version 2.1 | Version 4.1 |
| 2011 | Version 4.0 | Version 5.1 | Version 2.1 | Version 4.1 |
| 2012 | Version 5.2 | Version 5.1 | Version 2.1 | Version 4.1 |

ADM's approach to estimating appropriate market baselines was to assume that the national ENERGY STAR® market penetration percentages are a good representation of penetration in the SMUD service territory. While this assumption does serve to simplify the analysis, it is likely a reasonable assumption given that major retailers tend to set their retail stock on a national level. The market penetration percentages were then used to estimate market efficiency level baselines in the following fashion:

$$\text{Market efficiency baseline} = (\text{ES}\% * \text{ES}_{\text{minimum}}) + ((1 - \text{ES}\%) * \text{FS}_{\text{minimum}})$$

Where:

$$\text{ES}\% = \text{ENERGY STAR}\text{® market penetration percentage for appliance type (year prior to program year)}$$

¹⁵ ENERGY STAR® market penetration levels are based on shipment/sales data available at: http://www.energystar.gov/index.cfm?c=partners.unit_shipment_data

ES_{minimum} = Minimum ENERGY STAR® efficiency level

FS_{minimum} = Federal/State minimum efficiency level.

Using the market efficiency baselines for each appliance type, ADM then calculated per-unit and program level net savings estimates for each appliance type. The results of this analysis are presented in Section 4.4.

4.3 Self-Report Survey Analysis

In addition to the market efficiency level analysis, information collected from a sample of program participants through a participant survey was used as another approach to estimate the extent of free ridership. Appendix A provides a copy of the survey instrument. In total, 222 participants were surveyed.

Based on a review of the survey results, the preponderance of evidence regarding free ridership inclinations was used to assess the likelihood of participant free ridership and in turn estimate net savings.

Several criteria were used for determining what portion, if any, of a participant's savings for a particular project should be attributed to free ridership. The first criterion was based on the response to the question: "Would you have been financially able to purchase the [MEASURE] if you had not received the rebate through SMUD?" If a participant answered "No" to this question, a free ridership score of 0 was assigned to the project. That is, if a participant required financial assistance from the programs to undertake a project, then that participant was not deemed a free rider.

For participants that indicated that they were able to afford the appliances without financial assistance from the program, two factors were analyzed to determine what percentage of savings may be attributed to free ridership. The two factors are:

- What the participant would have done in the absence of the program;
- Influence that the program had on the decision to install a measure;

For each of these factors, rules were applied to develop binary variables indicating whether or not a participant's behavior showed free ridership. These rules made use of answers to questions on the participant survey questionnaire. A copy of the questionnaire is provided in Appendix A.

The first factor required determining if a participant stated that his or her intention was to purchase an appliance of the same efficiency even without the program. The answers to a combination of questions were used with a set of rules to determine whether a participant's behavior indicates likely free ridership. Two binary variables were constructed to account for participant intentions to purchase the efficient appliance without the program: one, based on a more restrictive set of criteria that may describe a high likelihood of free ridership, and a second, based on a less restrictive set of criteria that may describe a relatively lower likelihood of free ridership.

The first, more restrictive criteria indicating that the participant would have purchased the same appliance in the absence of the program that likely signify free ridership are as follows:

- The respondent answered “definitely would have” to the following questions: “If you had not received the SMUD rebate, how likely is it that you would have installed the same [MEASURE] anyway?”
- The respondent answered “No” to the question “When deciding about the [MEASURE], did you purchase a more efficient [MEASURE] than you otherwise would have because of the program rebate?”

The second, less restrictive criteria indicating that the participant would have purchased the same appliance in the absence of the program that likely signify free ridership are as follows:

- The respondent answered “probably would have” to the following questions: “If you had not received the SMUD rebate, how likely is it that you would have installed the same [MEASURE] anyway?”
- The respondent answered “No” to the question “When deciding about the [MEASURE], did you purchase a more efficient [MEASURE] than you otherwise would have because of the program rebate?”

The second factor required determining if a participant reported that the rebate influenced the decision to purchase the efficient appliance or if they purchased the equipment sooner because of the program. Evidence of the program’s influence on the decision would suggest a lower likelihood of free ridership. The criterion indicating that program influence may signify a lower likelihood of free ridership is that either of the following conditions are true:

- Either the respondent answered “very important” or “somewhat important” to the question “Overall, how important was SMUD’s rebate in your decision to purchase the high efficiency [MEASURE]?”
- Or the respondent answered either “Yes” to the question “Did the SMUD rebate cause you to purchase the energy efficient [MEASURE] sooner than you otherwise would have?”

The three sets of rules just described were used to construct three different indicator variables that address free ridership behavior. For each participant, a free ridership value was assigned based on the combination of variables. With the three indicator variables, there were six applicable combinations for assigning free ridership scores for each respondent, depending on the combination of answers to the questions creating the indicator variables. Table 28 shows these values.

Table 28: Free Ridership Scores for Combinations of Indicator Variable Responses

| Indicator Variables | | | Free Ridership Score |
|-------------------------------------|-----------------------------------|-------------------|----------------------|
| Absence of Program 1 (Definition 1) | Absence of Program (Definition 2) | Program Influence | |
| Y | NA | N | 100% |
| Y | NA | Y | 67% |
| N | Y | N | 33% |
| N | Y | Y | 0% |
| N | N | N | 0% |
| N | N | Y | 0% |

4.4 Results of Net Savings Estimation

The procedures described in the preceding sections were used to estimate free ridership rates and net to gross ratios for the Residential Appliance Efficiency Program for years 2010, 2011 and 2012.

4.4.1 Market Efficiency Level Results

Using the methodology described in Section 4.2, market efficiency levels were developed for each program year and each appliance type. The baseline kWh usages developed through this process are shown in Table 29.

Table 29: Market Baseline Efficiencies by Year and Appliance Type

| Appliance type | Federal/State Baseline | 2010 Market Baseline | 2011 Market Baseline | 2012 Market Baseline |
|-----------------|------------------------|----------------------|----------------------|----------------------|
| Dishwashers | 355 kWh | 342 kWh | 324 kWh | 325 kWh |
| Clothes Washers | 754 kWh | 673 kWh | 609 kWh | 618 kWh |
| Room ACs | 889 kWh | 863 kWh | 862 kWh | 838 kWh |
| Refrigerators | 697 kWh | 594 kWh | 627 kWh | 619 kWh |

Using the market baselines for each program year, ADM then calculated per-unit kWh savings for each appliance, program year, and CEE Tier. The results of this calculation are presented in Table 30.

Table 30: Per-Unit kWh Savings from Market Baseline

| Year | Dishwashers | | Clothes Washers | | | Room ACs | | Refrig. |
|------|-------------|------------|-----------------|------------|------------|------------|------------|------------|
| | CEE Tier 1 | CEE Tier 2 | CEE Tier 1 | CEE Tier 2 | CEE Tier 3 | CEE Tier 1 | CEE Tier 2 | CEE Tier 3 |
| 2010 | 11 | 26 | 126 | 181 | 225 | 92 | 125 | N/A |
| 2011 | 0 | 8 | 117 | 161 | 199 | 91 | 124 | N/A |
| 2012 | 38 | N/A | 170 | 208 | 71 | 67 | 100 | 131 |

Finally, these per-unit savings values were multiplied by the number of units rebated through the program as a first assessment of net savings. Table X below shows the market baseline savings as compared to ex post gross savings, by measure type.

Table 31: Market Baseline Program Savings by Measure

| <i>Appliance Type</i> | <i>Ex Ante Gross kWh Savings</i> | <i>Ex Post Gross kWh Savings</i> | <i>Market Baseline kWh Savings</i> | <i>Market Baseline / Ex Post Gross Savings</i> |
|-----------------------|----------------------------------|----------------------------------|------------------------------------|--|
| Dishwashers | 74,632 | 24,125 | 12,788 | 53% |
| Clothes Washers | 840,157 | 661,060 | 360,804 | 55% |
| Room AC | 300,670 | 197,932 | 142,736 | 72% |
| Refrigerators | 23,332 | 52,887 | 33,203 | 63% |
| Total | 1,238,791 | 936,005 | 549,530 | 59% |

4.4.2 Self-Report Survey Results

The self-report data used to assign free ridership scores for the Residential Appliance Efficiency Program were collected through a survey of 222 participants who received a rebate for an energy efficient appliance during the years 2010, 2011 and 2012.

As discussed in Section 4.3, the first criteria for determining what proportion of energy savings from a project should be assigned to free ridership was whether a participant was financially able to purchase the appliance without financial assistance from the program. If a decision maker respondent answered “No” to the question of “Would you have been financially able to purchase the [MEASURE] if you had not received the rebate through SMUD??” a free ridership score of 0 was assigned to the project. That is, if a participant required financial assistance from the program to undertake a project, then that participant was judged to not be a free rider.

Under this criterion, the other free ridership scoring criteria were applied only to projects for participants who answered “Yes” to the question: “Would you have been financially able to purchase the [MEASURE] if you had not received the rebate through SMUD?”

Table 32 shows the percentage of survey respondents who relayed the following: They had the financial ability to purchase the appliance without the rebate, they would have purchased an energy efficient appliance without the program (under two alternative definitions as described in the preceding section) and that the program influenced their decision to install the measure.

Table 32: Average Indicator Variable Values

| Indicated value | Variable | | | |
|----------------------|-----------------------|-----------------------------------|-----------------------------------|-------------------|
| | Had financial ability | Absence of Program (Definition 1) | Absence of Program (Definition 2) | Program Influence |
| Dishwasher | 89% | 38% | 13% | 64% |
| Clothes Washer | 88% | 37% | 13% | 63% |
| Room Air Conditioner | 94% | 38% | 9% | 56% |
| Refrigerator | 90% | 42% | 16% | 63% |

Table 33 shows percentages of Residential Appliance Efficiency Program participant survey responses that are associated with different combinations of free ridership indicator variable values. Twelve percent or fewer of the survey respondents indicated that they were financially unable to purchase the appliance without the rebate. For each appliance type, the largest share of survey respondents indicated that they would not have purchased an energy efficient appliance without the program and that the program influenced the decision to purchase the appliance.

Table 33: Estimated Free ridership for Rebated Appliances

| Indicator Variables | | | Free Ridership Score | Percent of Respondents | | | |
|--|-----------------------------------|-------------------|----------------------|-------------------------|----------------------|-----------------------------|--------------------|
| Absence of Program 1 (Definition 1) | Absence of Program (Definition 2) | Program Influence | | Clothes Washers (n=172) | Refrigerators (n=88) | Room Air Conditioner (n=32) | Dishwashers (n=61) |
| Y | NA | N | 100% | 24% | 24% | 28% | 25% |
| Y | NA | Y | 67% | 12% | 17% | 9% | 13% |
| N | Y | N | 33% | 5% | 5% | 3% | 0% |
| N | Y | Y | 0% | 6% | 9% | 3% | 11% |
| N | N | N | 0% | 6% | 8% | 13% | 10% |
| N | N | Y | 0% | 34% | 27% | 38% | 30% |
| Required program incentives to implement | | | | 12% | 10% | 6% | 11% |

The results of the self-report survey analysis were used to develop measure level “self-report NTG ratios.” These ratios, along with the resulting self-report net kWh savings, for the Appliance Program during the years 2010, 2011 and 2012 are summarized by appliance type in Table 34. Overall, the self-report analysis suggests an overall program level NTG ratio of 66%.

Table 34: Summary of Net kWh Estimates from Self-Report Surveys

| <i>Appliance Type</i> | <i>Ex Ante Gross kWh Savings</i> | <i>Ex Post Gross kWh Savings</i> | <i>Self-Report Net kWh Savings</i> | <i>Self-Report NTG Ratio</i> |
|-----------------------|----------------------------------|----------------------------------|------------------------------------|------------------------------|
| Dishwashers | 74,632 | 24,125 | 16,164 | 67% |
| Clothes Washers | 840,157 | 661,060 | 436,300 | 66% |
| Room AC | 300,670 | 197,932 | 128,656 | 65% |
| Refrigerators | 23,332 | 52,887 | 33,319 | 63% |
| Total | 1,238,791 | 936,005 | 617,763 | 66% |

4.4.3 Realized Net Impacts

The two methodologies used to estimate NTG ratios for the Appliance Program resulted in similar outcomes. The market efficiency baseline approach resulted in program level NTG ratio of 59%, while the self-report survey analysis resulted in an estimate of 66%. Because both approaches offer unique perspectives, and because neither approach attempted to quantify potential spillover effects, ADM decided to average the two results in order to determine a final program level NTG ratio.

The realized gross and net electric savings for the Residential Appliance Efficiency Program during the years 2010, 2011 and 2012 are summarized by appliance type in Table 34. During this period, realized net kWh savings for the program totaled 581,985 kWh. The final net to gross ratio for the Residential Appliance Efficiency Program is 62%.

Table 35: Summary of kWh Savings for the Residential Appliance Efficiency Program

| <i>Appliance Type</i> | <i>Expected kWh Savings</i> | <i>Realized Gross kWh Savings</i> | <i>Realized Net kWh Savings</i> | <i>Net to Gross Ratio</i> |
|-----------------------|-----------------------------|-----------------------------------|---------------------------------|---------------------------|
| Dishwashers | 74,632 | 24,125 | 14,476 | 60% |
| Clothes Washers | 840,157 | 661,060 | 398,552 | 60% |
| Room AC | 300,670 | 197,932 | 135,696 | 69% |
| Refrigerators | 23,332 | 52,887 | 33,261 | 63% |
| Total | 1,238,791 | 936,005 | 581,985 | 62% |

The realized net peak kW reductions for Residential Appliance Efficiency Program during the years 2010, 2011 and 2012 are summarized in Table 36. The same measure level NTG ratios used for annual kWh savings were applied to peak demand reduction. The achieved net peak demand savings for the program are kW.

Table 36: Summary of Net Peak kW Savings for the Residential Appliance Efficiency Program

| <i>Indicated value</i> | <i>Realized Net Peak kW</i> |
|------------------------|-----------------------------|
| Clothes Washer | 3.03 |
| Refrigerator | 51.29 |
| Room Air Conditioner | 181.76 |
| Dishwasher | 5.88 |
| Total | 241.96 |

4.5 Potential Spillover effects

As mentioned earlier in this Chapter, ADM did not directly quantify spillover effects, as they are likely small relative to the overall program impacts. However, the participant and non-participant surveys did contain questions designed to provide a qualitative depiction of potential program spillover. Spillover is an externality of the program, meaning it is impacts that are not quantified as in the gross savings, but is attributable to the program. An example of spillover would be if, through the program, a household purchased a SMUD-rebated ENERGY STAR refrigerator and then decided to also buy an efficient freezer, without receiving any rebates. The purchase of the refrigerator unintentionally prompted the purchase of the freezer, resulting in additional savings that are not captured in the program tracking system. Relative to gross savings, spillover effects are likely small and difficult to quantify with an acceptable level of uncertainty.

4.5.1 Additional Equipment Purchase and Installation

In order to assess program participants' involvement in other energy efficiency improvements, respondents were asked whether they had installed any additional, non-incentivized energy efficient equipment in their home in the past year. As shown in Table 37, 19% of the 222 respondents reported that they had made at least one such energy efficiency improvement.

Table 37: Additional Purchase of Non-Incentivized Energy Efficient Equipment

| In the past year, have you installed any energy efficient equipment in your home that you have not received an incentive for? | <i>Response</i> | <i>(n=222)</i> | <i>Percent of Respondents</i> |
|---|-----------------|----------------|-------------------------------|
| | Yes | 42 | 19% |
| | No | 177 | 80% |
| | DK | 3 | 1% |
| | RF | 0 | 0% |

Of the 42 respondents who reported that they had installed additional non-incentivized energy efficient equipment, 37 explained what specific equipment they had purchased. The most commonly reported measures included:

- Refrigerators (7 out of 37 respondents, 19%)
- Dishwashers (6 out of 37 respondents, 16%)
- Lighting (5 out of 37 respondents, 14%)
- Air conditioners (4 out of 37 respondents, 11%)
- Washing machines (4 out of 37 respondents, 11%)

Other reported measures included water heaters (3), stoves/ovens (3), and televisions (2). Additionally, nine respondents reported that they had purchased energy efficient clothes dryers. As dryers are currently classified as Emerging Technologies by ENERGY STAR® and there are few dryers in the current market that would qualify as particularly energy efficient, it is unlikely that the dryers cited by these respondents are “certified” high efficiency models. These respondents may have purchased a dryer that accompanies their energy efficient clothes washer, which may lead to the assumption that both the washer and the dryer are energy efficient.

These purchases may represent potential program spillover effects, depending on the level of influence the Appliance Program had on their decision to purchase other, non-rebated appliances. Given that a number of measures reported by participant survey respondents are eligible for rebates through the Appliance Program, it is possible that they may not have been efficient enough to qualify under SMUD’s program requirements.

4.5.1 Additional Equipment Purchase and Installation by Non-participants

In order to gauge non-participant energy efficiency improvements outside of the rebate programs, respondents were asked whether they had installed any energy efficient equipment within the past year without receiving an incentive. Three-quarters of non-participant respondents reported that they had not made any such purchases. The remaining 24% of respondents were asked to identify the specific equipment that they had purchased without an incentive.

Table 38: Non-Incentivized Energy Efficient Equipment Installation

| In the past year, have you installed any other energy efficient equipment in your home that you have not received an incentive for? | Response | (n=50) | Percent of Respondents |
|---|----------|--------|------------------------|
| | Yes | 12 | 24% |
| | No | 38 | 76% |
| | DK | 0 | 0% |
| | RF | 0 | 0% |

Of the 12 non-participant respondents who reported that they had installed additional energy efficient equipment, 11 explained what specific equipment they had purchased. The most commonly reported measures included freezers (2) and lighting (2). Additional reported measures included windows, a smart thermostat, and a water pump.

These results suggest that while some non-participants have recently purchased non-incentivized equipment, there may not have been an opportunity to receive rebates from SMUD. Most of the reported measures would not qualify for rebates under the Appliance Program, and the actual efficiency level of these measures is not clear. Additionally, none of the non-participant survey respondents suggested the purchases were influenced by a SMUD energy efficiency program.

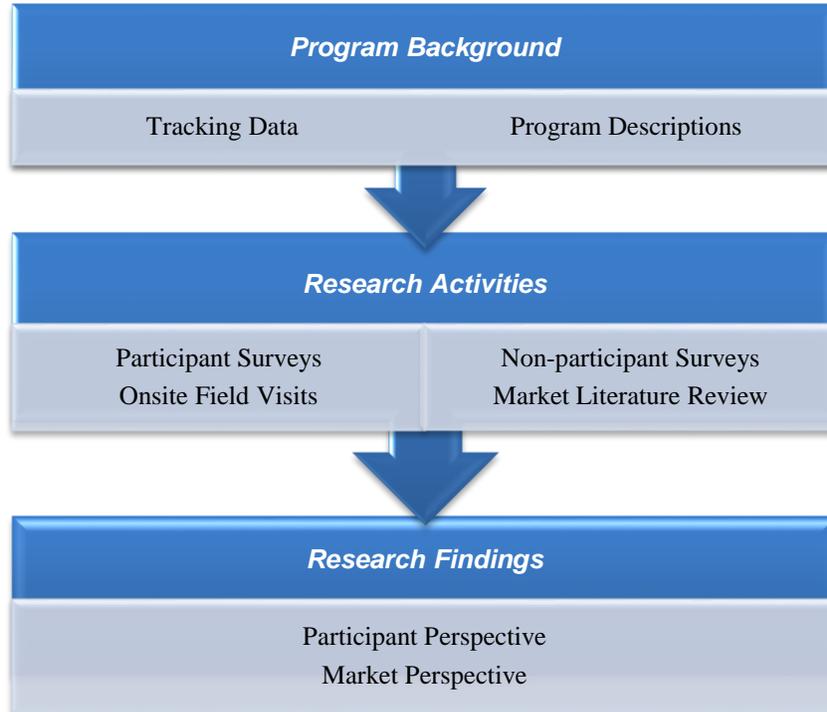
5. Process Evaluation

This chapter discusses results of the SMUD Residential Appliance Efficiency Program process evaluation activities for the 2010-2012 program years. The purpose of the process evaluation is to assess the program from a structural and market perspective in order to characterize program context, strengths, and weaknesses. This evaluation is based upon surveys with program participants and non-participants, onsite visits to retail stores and customer homes and businesses, and reviews of program documentation and relevant market literature.

This chapter begins with a description of the process evaluation objectives, and a summary of the program design, background and structure. This is followed by a discussion of the results from the 2010-2012 Appliance Program participant survey and non-participant survey. The chapter continues by presenting the results of field visits to retail stores, homes, and businesses. Next, the chapter provides a characterization of program penetration and market potential. The chapter concludes by highlighting key findings and program recommendations resulting from the process evaluation.

5.1 Evaluation Objectives

The purpose of the process evaluation is to examine program operations and results throughout the program operating years, and to identify potential program improvements that may prospectively increase program efficiency or effectiveness in terms of participation and satisfaction levels. This process evaluation was designed to document the operations and delivery of the Appliance Program during the 2010-2012 program years. Figure 2 provides an overview of the evaluation process, including the research activities performed.

Figure 2: Process Evaluation Overview

Key research questions addressed by this evaluation of the 2010-2012 program years include:

- Which marketing channels are most effective? What barriers to participation exist?
- Were the program participants satisfied with their experience? Are customers sufficiently aware of available rebates and energy efficient equipment?
- How well is the program performing in the market? How much future potential exists for program growth and continued success?
- Are there incentive processing, data tracking, settlement, and/or communication efficiencies that can be gained?
- Looking forward, what are the key barriers and drivers to program success within SMUD's market?

During the evaluation, data and information from several sources were analyzed to achieve the stated research objectives. Insight into the participant perspective on the program was developed from telephone surveys conducted with participants of the program from the 2010-2012 program years, as well as visits to a selected sample of participant homes. The non-participant market perspective was addressed through surveys with SMUD customers who are not listed as having received an Appliance Program rebate during 2010-2012. The market perspective also gains insight from field visits to appliance retail stores, interviews with retail employees, and shelf level

inventory assessments. Additionally, ADM conducted research activities in order to understand the context, structure, and market potential of the program by analyzing ENERGY STAR® market data and reviewing program documentation such as promotional literature and participant tracking data.

5.2 Summary of Primary Data Collection

The three primary data collection activities used to support this process evaluation are listed below:

- **Participant Surveys:** Participant surveys serve as the foundation for understanding the participant perspective. The participant surveys provide participant feedback and insight regarding participant experiences with the Appliance Program. Respondents report on their satisfaction with the program, detail their motivations and the factors affecting their participation decisions, and provide recommendations related to improving the program. Additionally, participants provide details regarding their non-rebated appliances as well as demographic information. ADM field staff also conducted visits for a small sub-sample of participant homes in order to administer a short follow-up survey and to potentially monitor appliance energy usage. For the 2010-2012 Residential Appliance Efficiency Program evaluation, 222 program participants responded to the participant telephone survey, while follow-up home visits were conducted at 15 participant residences.
- **Non-participant Surveys:** Surveys with SMUD customers who are not listed as program participants serve to gain insight into the broader customer perspective. SMUD provided a list of non-participant customers and their contact information, and survey respondents were reached through random sampling. Non-participant customers provide information regarding their existing appliances, their appliance purchasing behaviors, their awareness of SMUD rebate programs and likelihood of participation, and demographic information. In total, 50 non-participant customers responded to this telephone survey.
- **Retail Visits:** Visits to appliance retail stores in the SMUD service territory provide insight into the shelf level inventory of energy efficient and standard efficiency appliances. Additionally, interviews with retail store employees provide information regarding customer preferences, program awareness, and purchasing behaviors. Field staff conducted visits to five appliance retail stores in the SMUD service territory and interviewed one sales employee at each location.

5.3 Program Overview

The Residential Appliance Efficiency Program is designed to provide incentives for SMUD's residential customers to purchase and install energy efficient equipment in their homes and to educate customers about the benefits and available opportunities within energy efficient improvements. The rebate portion of the program evaluated by ADM

offers incentives for clothes washers, dishwashers, room air conditioners, and refrigerators that meet energy efficiency guidelines. Specifically, products must meet certain tiers of Consortium of Energy Efficiency (CEE) certification and be included on the eligible list of products for each measure. Additionally, clothes washers and dishwashers must be served by an electric heating source in order to remain eligible.

After purchasing one or more eligible measures, customers fill out the respective rebate application form and submit it to SMUD. The application form must be submitted within 60 days of purchase, and requires various pieces of information including:

- Water service provider information (if applicable);
- Customer name, address, and contact information;
- Location of measure installation;
- Measure characteristics (CEE tier, capacity, other details as applicable); and
- Agreement to program rules and payment terms.

In addition to the rebate form, customers are required to enclose a copy of their water or electric bill and a copy of their purchase receipt for the measure. These documents serve to verify that the equipment was purchased and that the purchaser is a SMUD customer.

If all information is verified to be accurate and complete, rebate checks are mailed within 6-8 weeks of application submission.

5.4 Participant Outcomes

A telephone survey was conducted to collect data about participant decision-making, preferences, and opinions of the Residential Appliance Efficiency Program. This survey also served to inform the impact analysis, market characterization review, and net-to-gross findings. In total, 222 participants fully responded to the survey.

5.4.1 Program Awareness and Marketing

The participant survey included several questions related to the marketing and promotion of the Appliance Program. Respondents were asked how they first heard about the program, and Table 39 shows that the most common method of awareness was through retail stores (39% of respondents). This was followed by SMUD bill inserts, which were cited by 28% of respondents. Very few respondents reported learning about the program through contractors, print advertisements, or radio advertisements.

These results suggest that participants commonly learn about the program at the point of purchase, although from this question in isolation it is unclear whether these participants made their appliance purchases at the time of initial awareness or instead returned to the store at a later time.

Table 39: Method of Initial Program Awareness

| | <i>Response</i> | <i>(n=222)</i> | <i>Percent of Respondents</i> |
|---|--------------------------|----------------|-------------------------------|
| Could you tell me how you heard about the Residential Appliance Efficiency Program? | Retail Store | 86 | 39% |
| | SMUD Bill Insert | 62 | 28% |
| | SMUD website | 18 | 8% |
| | Other | 15 | 7% |
| | Word-of-Mouth | 11 | 5% |
| | Don't know | 11 | 5% |
| | Direct Mail from Utility | 8 | 4% |
| | Contractor | 5 | 2% |
| | Print Ad | 5 | 2% |
| | Radio | 1 | 0% |

In order to address the timing of participation, respondents were asked how long they knew about the program prior to making the decision to participate. As shown in Table 40, approximately one-third of respondents indicated that they learned about the program at the time of purchase, while another 38% of respondents indicated that they knew about the program for at least a month prior to participating. This indicates that although some of the participants who learned about the program from a retail store did not make their appliance purchase until a later date, the majority of retail-informed participants immediately proceeded with their purchase.

These results suggest that the Appliance Program is effective as an in-store sales tool, although these questions alone do not imply a specific level of program influence on customer decision making. Program influence factors are considered during the free-ridership and spillover savings analysis for the program; this methodology is fully outlined in the Net Savings chapter of this report.

Table 40: Awareness Prior to Participation

| | <i>Response</i> | <i>(n=222)</i> | <i>Percent of Respondents</i> |
|--|---|----------------|-------------------------------|
| How long had you known about the program and its rebates before you decided to participate in the program? | Learned about program at time of purchase | 71 | 32% |
| | Less than a week | 13 | 6% |
| | Less than a month | 7 | 3% |
| | A month or more | 85 | 38% |
| | Don't know | 0 | 0% |
| | Refused | 0 | 0% |

5.4.2 Rebates Received

In order to gain insight into the distribution of program appliances among respondents, each participant respondent was asked to identify which measure(s) they purchased

through the Appliance Program. This line of questioning was required as a result of the fact that program tracking data did not directly identify which appliances were purchased by which participants. As shown in Table 41, the majority of respondents (77%) had purchased clothes washers, while 40% of respondents had purchased refrigerators. The number of respondents indicating they received a refrigerator rebate is surprisingly high, considering the rebates were only offered in 2012. As some participants received rebates for multiple appliances, respondents were able to select more than one measure.

The responses to this question were used to direct respondents through the survey so that they would be asked a specific series of questions based on which measure(s) they had purchased through the program.

Table 41: Rebates Received by Participant Respondents

| <i>Rebated Measure</i> | <i>Percentage of Respondents Receiving Rebate (n=222)</i> |
|------------------------|---|
| Clothes Washer | 77% |
| Refrigerator | 40% |
| Room Air Conditioner | 14% |
| Dishwasher | 27% |

5.4.3 Clothes Washers

Respondents who indicated that they had received a rebate for purchasing an energy efficient clothes washer through the SMUD program were asked a series of questions regarding this unit. First, these respondents were asked whether they currently use the clothes washer that was rebated, and 96% of respondents stated that they do. Next, respondents were asked to provide their usage schedule for the clothes washer. These questions inform the savings analysis and provide information regarding customer energy usage patterns. As shown in Table 42, the majority of respondents (63%) reported that they typically run their clothes washers on both weekdays and weekends. Table 43 shows that the majority of respondents (69%) run their clothes washer at least two times per week, with more than a quarter of respondents (27%) stating that they run their washer more than four times per week.

Table 42: Participant Timing of Clothes Washer Usage

| | <i>Response</i> | <i>(n=172)</i> | <i>Percent of Respondents</i> |
|---|---------------------|----------------|-------------------------------|
| When do you normally run this clothes washer? | During weekdays | 34 | 20% |
| | During weekends | 26 | 15% |
| | During weekdays and | 108 | 63% |
| | DK | 4 | 2% |
| | Refused | 0 | 0% |

Table 43: Participant Frequency of Clothes Washer Usage

| | <i>Response</i> | <i>(n=172)</i> | <i>Percent of Respondents</i> |
|---|-------------------------------|----------------|-------------------------------|
| How many times per week do you typically run this clothes washer? | Less than one time per week | 2 | 1% |
| | One time per week | 19 | 11% |
| | Two times per week | 36 | 21% |
| | Three times per week | 36 | 21% |
| | More than four times per week | 47 | 27% |
| | DK | 2 | 1% |
| | Refused | 0 | 0% |

The 43 respondents who did not receive a clothes washer rebate through the SMUD program were asked whether they currently own a clothes washer. Eighty-eight percent of these respondents reported that they do currently own a clothes washer. These respondents were then asked a short series of questions about their clothes washer in order to gather information for characterizing the existing pool of non-program appliances.

As shown in Table 44, the majority of respondents (52%) reported that their clothes washer is 5 years old or newer. Approximately one-quarter (26%) of respondents indicated that their clothes washer is more than 10 years old.

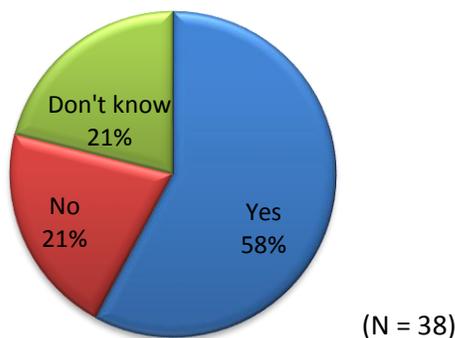
Table 44: Age of Participants' Non-Program Clothes Washers

| | <i>Response</i> | <i>(n=38)</i> | <i>Percent of Respondents</i> |
|---|------------------------|---------------|-------------------------------|
| How old is your current clothes washer? | Less than a year old | 1 | 3% |
| | 1-2 years old | 8 | 21% |
| | 3-5 years old | 11 | 29% |
| | 6-10 years old | 4 | 11% |
| | More than 10 years old | 10 | 26% |
| | DK | 4 | 11% |
| | Refused | 0 | 0% |

In order to gather further information regarding these existing clothes washers, respondents were then asked whether their current clothes washer is energy efficient. The survey prompted respondents with a short statement regarding energy efficiency, explaining that the ENERGY STAR® label is the most common identifier of an energy efficient unit. Figure 3 shows that the majority (58%) of respondents reported having energy efficient clothes washers. Twenty-one percent of respondents indicated that their current clothes washer is not energy efficient.

Figure 3: Energy Efficiency of Participants' Non-Program Clothes Washers

**Is your current clothes washer energy efficient?
Energy efficient clothes washers most commonly have an Energy Star® label.**



When asked if they planned to replace their clothes washer with a newer model in the next two years, only one of these respondents stated that they were planning to do this. This respondent reported that they are planning to replace the clothes washer within the next six months, and that they will purchase an ENERGY STAR® model.

5.4.4 Refrigerators

Respondents who reported receiving a rebate for an energy efficient refrigerator were asked a series of questions about the rebated unit. Ninety-four percent of these respondents reported that they currently use the refrigerator that was rebated through the program.

In terms of unit types, Table 45 shows that respondents had a fairly even distribution of refrigerators. Bottom-freezer refrigerators were the most commonly cited style, followed by side-by-side refrigerators.

Table 45: Type of Refrigerators Rebated

| What kind of refrigerator model did you purchase? | Response | (n=88) | Percent of Respondents |
|---|--------------------------------|--------|------------------------|
| | Top-freezer refrigerator model | 19 | 22% |
| | Bottom-freezer refrigerator | 41 | 47% |
| | Side-by-Side refrigerator | 26 | 30% |
| | DK | 1 | 1% |
| | RF | 1 | 1% |

When asked, 99% of the remaining 113 survey respondents who had not received a refrigerator rebate through the program reported that they currently own a refrigerator. These respondents were then asked a short series of questions about their existing primary refrigerator (the refrigerator they use most often) in order to gather information for characterizing the existing pool of non-program appliances.

Table 46 shows that more than a third (39%) of respondents' refrigerators are over 10 years old, and that 13% of respondents' refrigerators are two years old or less.

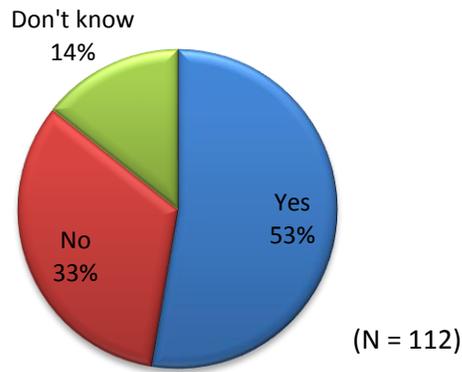
Table 46: Age of Participants' Non-Program Refrigerators

| How old is your current refrigerator? | Response | (n=112) | Percent of Respondents |
|---------------------------------------|------------------------|---------|------------------------|
| | Less than a year old | 3 | 3% |
| | 1-2 years old | 11 | 10% |
| | 3-5 years old | 25 | 22% |
| | 6-10 years old | 27 | 24% |
| | More than 10 years old | 44 | 39% |
| | DK | 2 | 2% |
| | RF | 0 | 0% |

Respondents were then asked whether their current refrigerator is energy efficient (labeled with ENERGY STAR® certification), with result shown in Figure 4. The majority of respondents (53%) stated that their refrigerator is energy efficient, while one-third of respondents reported that their refrigerator is not energy efficient.

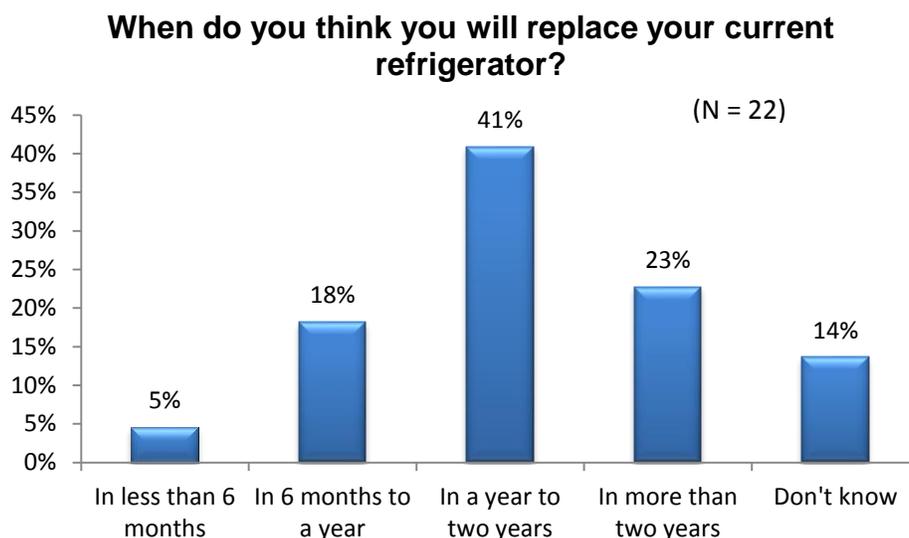
Figure 4: Energy Efficiency of Participants' Non-Program Refrigerators

Is your current refrigerator energy efficient? Energy efficient refrigerators most commonly have an Energy Star® label.



When asked, one-fifth of respondents indicated that they planned to replace their refrigerators with newer models within two years. In terms of timing, Figure 5 shows that five percent of these respondents have immediate plans to replace their refrigerator within the next six months, but that the majority of these respondents believe that it will be a year or more before the replacement occurs. Nearly one-quarter (23%) of these respondents stated that it will actually be more than two years before the replacement occurs, which suggests that they likely have not have started thinking seriously about purchasing a new refrigerator.

Figure 5: Timing of Future Non-Program Refrigerator Replacement



When asked about the likely efficiency level of the replacement refrigerator, more than three-quarters (77%) of the respondents who were planning a replacement stated that they would purchase an ENERGY STAR® model. Only two respondents (9%) indicated that they would be purchasing a standard efficiency refrigerator as a replacement.

Table 47: Estimated Energy Efficiency of Future Refrigerator Replacement

| What type of refrigerator do you think you will purchase? | Response | (n=22) | Percent of Respondents |
|---|--|--------|------------------------|
| | An energy efficient/ENERGY STAR® model | 17 | 77% |
| A standard efficiency model | 2 | 9% | |
| Not sure about efficiency, but an inexpensive model | 0 | 0% | |
| Not sure about efficiency, but a high-end model | 1 | 5% | |
| DK | 2 | 9% | |
| RF | 0 | 0% | |

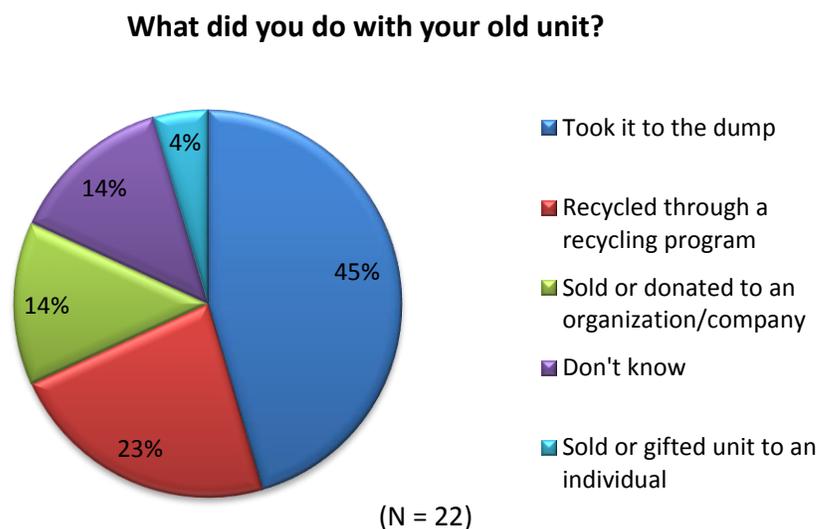
5.4.5 Room Air Conditioners

Respondents who reported receiving a rebate for an energy efficient room air conditioner were also asked a series of questions regarding this unit. First, 88% of these respondents reported that they currently use the room air conditioner that was rebated through the program. When asked why the room air conditioner was purchased, responses were distributed fairly evenly across three categories as shown in Table 48. While more than a third (38%) of respondents indicated that the new room air conditioner replaced a broken unit, nearly a third (31%) stated that the new room air conditioner replaced a functioning unit. Additionally, 28% of respondents stated that the new room air conditioner was not a replacement.

Table 48: Purpose of Rebated Air Conditioner Purchase

| Was this air conditioner purchased: | Response | (n=32) | Percent of Respondents |
|-------------------------------------|-------------------------------|--------|------------------------|
| | To replace a functioning unit | 10 | 31% |
| | To replace a broken unit | 12 | 38% |
| | Not a replacement | 9 | 28% |
| | DK | 1 | 3% |
| | RF | 0 | 0% |

The respondents who indicated that the new room air conditioner was a replacement were asked what they did with their old unit. As shown in Figure 6, respondents most commonly reported that they took their old room air conditioner to the dump, while 23% of respondents indicated that they recycled the unit through a recycling program. Only a small percentage of respondents provided responses that implied that the old unit was still operational.

Figure 6: Method of Disposal for Prior Air Conditioner Units

When asked, only 14% of the remaining 178 survey respondents who did not receive a room air conditioner rebate reported that they currently own a room air conditioner. These respondents were then asked a short series of questions about their existing room air conditioner in order to gather information for characterizing the existing pool of non-program appliances.

Table 49 shows a wide range of ages for these respondents' air conditioners. While 36% of respondents reported that their air conditioners are more than six years old, 24% indicated that their units are two years old or less.

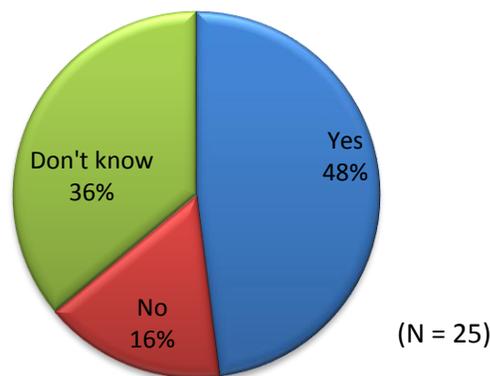
Table 49: Age of Participants' Non-Program Air Conditioners

| | Response | (n = 25) | Percent of Respondents |
|---|------------------------|----------|------------------------|
| How old is your current room air conditioner? | Less than a year old | 1 | 4% |
| | 1-2 years old | 5 | 20% |
| | 3-5 years old | 5 | 20% |
| | 6-10 years old | 4 | 16% |
| | More than 10 years old | 5 | 20% |
| | Don't know | 5 | 25% |

In terms of energy efficiency, nearly half (48%) of the non-program air conditioner owners stated that their current air conditioner is energy efficient. Only 16% of the respondents stated that their current unit is not an energy efficient model.

Figure 7: Energy Efficiency of Participants' Non-Program Air Conditioners

Is your current room air conditioner energy efficient? Energy efficient air conditioners most commonly have an Energy Star® label.



When asked if they planned to replace their current room air conditioner with a newer model in the next two years, only one respondent confirmed that they were planning to do this. This respondent reported that they will be replacing their room air conditioner in one to two years, and that it will be an ENERGY STAR® model. One other respondent indicated that they planned to replace their air conditioner with an ENERGY STAR® model in more than two years.

5.4.6 Dishwashers

Respondents who reported receiving a dishwasher rebate through the program were asked a series of questions about the unit in order to gain insight into usage schedules.

First, 87% of these respondents reported that they currently use the dishwasher that was rebated through the program.

As shown in Table 50, the majority of respondents (61%) reported that they run the rebated dishwasher on both weekdays and weekends, and only five percent of respondents indicated that they exclusively run the dishwasher on weekends.

Table 50: Timing of Participant Respondent Dishwasher Usage

| | <i>Response</i> | <i>(n=61)</i> | <i>Percent of Respondents</i> |
|---|------------------------------|---------------|-------------------------------|
| When do you normally run this dishwasher? | During weekdays | 17 | 28% |
| | During weekends | 3 | 5% |
| | During weekdays and weekends | 37 | 61% |
| | DK | 3 | 5% |
| | RF | 1 | 2% |

In terms of usage frequency, the majority of respondents (61%) stated that they run their dishwasher at least three times per week, with 16 respondents indicating that they run the unit more than four times per week.

Table 51: Frequency of Participant Respondent Dishwasher Usage

| | <i>Response</i> | <i>(n=61)</i> | <i>Percent of Respondents</i> |
|---|-------------------------------|---------------|-------------------------------|
| How many times per week do you typically run this dishwasher? | Less than one time per week | 5 | 8% |
| | One time per week | 8 | 13% |
| | Two times per week | 10 | 16% |
| | Three times per week | 15 | 25% |
| | Four times per week | 6 | 10% |
| | More than four times per week | 16 | 26% |
| | DK | 0 | 0% |
| | RF | 1 | 2% |

When asked, 84% of the remaining 145 respondents who had not received a dishwasher rebate stated that they currently own a dishwasher. These respondents were then asked a short series of questions about their existing dishwasher in order to gather information for characterizing the existing pool of non-program appliances.

Table 52 shows that most of these respondents' dishwashers are at least six years old, with 25% being more than 10 years old. On average, non-program dishwashers owned by program participants appear to be older than other participant appliances.

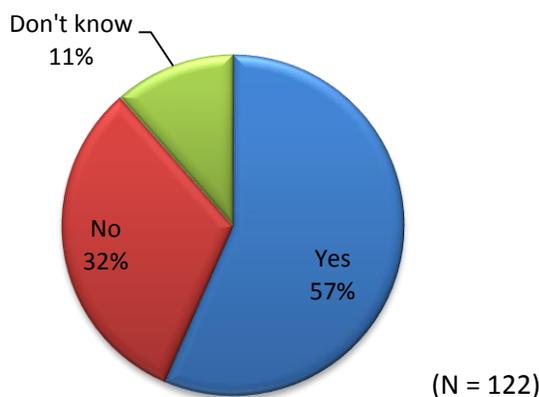
Table 52: Age of Participants' Non-Program Dishwashers

| | <i>Response</i> | <i>(n=122)</i> | <i>Percent of Respondents</i> |
|-------------------------------------|------------------------|----------------|-------------------------------|
| How old is your current dishwasher? | Less than a year old | 4 | 3% |
| | 1-2 years old | 19 | 16% |
| | 3-5 years old | 21 | 17% |
| | 6-10 years old | 37 | 30% |
| | More than 10 years old | 31 | 25% |
| | DK | 10 | 8% |
| | RF | 0 | 0% |

When asked about energy efficiency, respondents reported that the majority of non-program dishwashers (57%) are energy efficient. In contrast, nearly one-third of these respondents stated that their dishwasher is not an energy efficient unit. This relatively high presence of standard efficiency non-program dishwashers may be related to the fact that many of these units are several years old.

Figure 8: Energy Efficiency of Participants' Non-Program Dishwashers

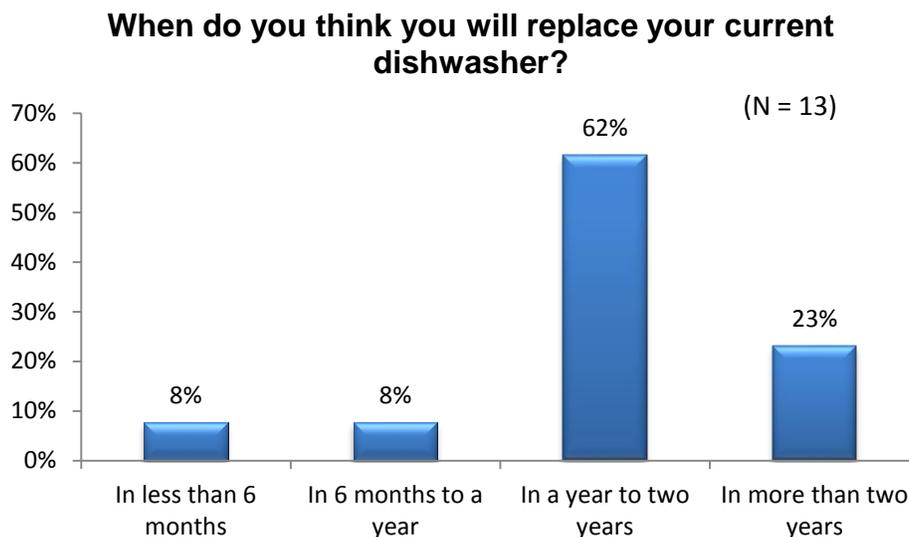
Is your current dishwasher energy efficient? Energy efficient dishwashers most commonly have an Energy Star® label.



When asked whether they planned to replace these non-rebated dishwashers, only 11% of respondents reported that they are planning to replace the unit within the next two years. All but one of these 13 respondents stated that they would be purchasing an ENERGY STAR® dishwasher.

However, when asked about the specific planned timing of this replacement, nearly one-quarter (23%) of these respondents stated that it will actually be more than two years before they replace the dishwasher. Thus, only 10 out of the 122 respondents who own non-rebated dishwashers confirmed that they are planning to replace their existing dishwasher in two years or less.

Figure 9: Timing of Future Replacement of Participants' Non-Program Dishwashers



These results suggest that while there is likely a substantial potential for current program participants to replace their dishwashers with energy efficient units, very few of them are actually planning to purchase a new unit in the near future.

5.4.7 Participant Satisfaction

In order to assess participant observation and satisfaction with savings, respondents were asked whether they had noticed any savings since installing their energy efficient appliance. As shown in Table 53, respondents who purchased air conditioners through the program were the most likely to have noticed energy savings. In contrast, only 18% of respondents had noticed energy savings from their energy efficient dishwasher that was rebated through the program. Overall, the majority of participants reported that they had not noticed energy savings after installing the measures. This is expected, as many customers may not closely analyze their monthly energy use. Additionally, seasonal effects, behavioral changes, and the purchase and use of other equipment would make it more difficult for participants to observe energy savings after installing an appliance.

Table 53: Observed Savings for Rebated Measures

| Have you noticed any savings on your... | Measure Type | Percentage of Respondents Indicating 'Yes' | N |
|---|-----------------|--|-----|
| | Clothes washer | 33% | 172 |
| | Refrigerator | 27% | 88 |
| | Air conditioner | 44% | 32 |
| | Dishwasher | 18% | 61 |

As a follow-up question, respondents who reported noticing energy savings from their appliances were asked to rate their level of satisfaction with these savings. Satisfaction ratings were provided on a scale ranging from very satisfied to very dissatisfied. As shown in Table 54, the majority of respondents within each measure category reported that they were very satisfied with the observed energy savings. Only two respondents indicated that they were at all dissatisfied with the energy savings. One of these respondents had purchased a clothes washer through the program, and the other had purchased a room air conditioner. These results suggest that while most participants have not noticed energy savings after installing their new appliances, those who have noticed savings view those savings as satisfactory.

Table 54: Participant Satisfaction with Observed Savings for Rebated Measures

| Measure Type | Satisfaction with Observed Measure Savings | | | | | | N |
|-----------------|--|--------------------|---------|-----------------------|-------------------|------------|----|
| | Very Satisfied | Somewhat Satisfied | Neutral | Somewhat Dissatisfied | Very Dissatisfied | Don't know | |
| Clothes washer | 66% | 2% | 28% | 2% | 0% | 2% | 57 |
| Refrigerator | 71% | 29% | 0% | 0% | 0% | 0% | 24 |
| Air conditioner | 79% | 14% | 0% | 0% | 7% | 0% | 14 |
| Dishwasher | 73% | 27% | 0% | 0% | 0% | 0% | 11 |

Respondents were also asked to rate their overall level of satisfaction with the appliance that had been rebated through the program. Table 55 shows that the majority of respondents within each measure category reported being very satisfied, while very few respondents reported being at all dissatisfied. None of the respondents who had received dishwasher rebates reported being dissatisfied with their dishwasher.

Table 55: Participant Satisfaction with Rebated Measures Overall

| Measure Type | Satisfaction with Measure Overall | | | | | | N |
|-----------------|-----------------------------------|--------------------|---------|-----------------------|-------------------|------------|-----|
| | Very Satisfied | Somewhat Satisfied | Neutral | Somewhat Dissatisfied | Very Dissatisfied | Don't know | |
| Clothes washer | 75% | 15% | 1% | 3% | 6% | 0% | 172 |
| Refrigerator | 72% | 22% | 1% | 1% | 3% | 1% | 88 |
| Air conditioner | 59% | 13% | 13% | 3% | 0% | 9% | 32 |
| Dishwasher | 72% | 27% | 2% | 0% | 0% | 0% | 60 |

- Dissatisfaction with Rebated Clothes Washers:** Sixteen respondents stated that they were somewhat dissatisfied or very dissatisfied with their rebated clothes washer. When asked to elaborate, these respondents most commonly explained that their clothes washer does not function as well as expected, or that it is not as effective at cleaning clothes as older models. Additionally, a few respondents stated that the clothes washer begins to emit an odor after repeated use, which requires regular cleaning. Specific explanations for clothes washer dissatisfaction include:

“I didn’t see a drop in my bill like they said, and it doesn’t do a good job on getting your clothes clean.”

“It doesn’t get clothes clean. I have to use a special detergent. It’s twice the work of the old one.”

“[With] a lot of front loaders, if you don’t keep it super clean and run cleaners through it, it develops an odor.”

- **Dissatisfaction with Rebated Refrigerators:** Four respondents indicated that they were somewhat dissatisfied or very dissatisfied with the refrigerator that had been rebated through the program. All of these respondents provided different reasons for their dissatisfaction, including:

“It doesn’t have as much storage [as my old refrigerator].”

“It’s horrible to clean and hard to get the shelves out.”

“We had the refrigerator [for] a week and it started breaking, and everything was plastic.”

These comments appear to be related to the specific model of refrigerator purchased rather than to a general characteristic of energy efficient refrigerators.

- **Dissatisfaction with Rebated Room Air Conditioners:** Only one respondent reported being at all dissatisfied with their rebated room air conditioner. This respondent did not elaborate on the reasoning behind their dissatisfaction, so it is unclear why the rating was given.

Overall, there were few instances of dissatisfaction with the rebated appliances, and many of the comments from respondents refer to anecdotal issues or issues with particular models. The only comments that may specifically be attributed to energy efficient appliances as a group are the statements from respondents who believe that their new clothes washer is not as effective at cleaning as their older models. However, these respondents represent a very small percentage of the sampled clothes washer rebate recipients, and the majority of respondents provided high satisfaction ratings for their new appliances.

Respondents were also asked about their levels of satisfaction with selected elements of the program. Responses were provided on a scale of very dissatisfied to very satisfied. Table 56 shows participant satisfaction for each listed program element.

Overall, participants reported fairly high levels of satisfaction with each program element. Aside from their overall program experience, respondents reported the highest average satisfaction levels with the rebate application process and rebate amount. Additionally, the majority of respondents indicated that they were very satisfied with any communications they had had with SMUD program staff.

Table 56: Participant Satisfaction Ratings by Program Element

| Element of Program Experience | Satisfaction Rating | | | | | | |
|-----------------------------------|---------------------|--------------------|---------|-----------------------|-------------------|------------|-----|
| | Very Satisfied | Somewhat Satisfied | Neutral | Somewhat Dissatisfied | Very Dissatisfied | Don't know | N |
| Rebate amount | 55% | 30% | 7% | 3% | 2% | 4% | 222 |
| Rebate application process | 59% | 27% | 6% | 3% | 3% | 2% | 222 |
| Communications with program staff | 58% | 17% | 9% | 2% | 2% | 13% | 222 |
| Overall program experience | 62% | 27% | 7% | 2% | 1% | 1% | 222 |

Respondents were given the opportunity to elaborate on any reported dissatisfaction with the listed program elements:

- **Dissatisfaction with Rebate Amount:** Ten respondents stated that they were somewhat dissatisfied or very dissatisfied with the appliance rebate amount. When asked to elaborate, these respondents mainly explained that the rebate was not large enough, or that it did not substantially offset the retail price of the appliance.
- **Dissatisfaction with Rebate Application Process:** Fourteen respondents indicated that they were somewhat dissatisfied or very dissatisfied with the rebate application process. Upon explaining their dissatisfaction, three of these respondents mentioned that the rebate was complicated, or that it asked for information that was not readily available. Another respondent noted that they had to resubmit the rebate application twice in order to receive a rebate.
- **Dissatisfaction with Program Staff Communications:** Eight respondents stated that they were somewhat dissatisfied or very dissatisfied with the communications they had had with SMUD program staff. Most of these respondents did not explain why they provided these ratings, but one respondent explained that they had contacted SMUD with questions about the program and had to wait a long time to receive answers. Another respondent commented on a somewhat related issue, stating that it had taken too long to receive the actual rebate from SMUD.
- **Dissatisfaction with Overall Program Experience:** Six respondents reported that they were somewhat dissatisfied or very dissatisfied with their overall program experience. When asked to elaborate, most of these respondents used the opportunity to restate the reasons for any dissatisfaction they had with the other listed program elements.

Although there were instances of reported dissatisfaction within each listed program element, dissatisfaction was fairly minimal overall. More than 90% of respondents

indicated that they were very satisfied, somewhat satisfied, or had neutral perceptions of each program element.

Respondents were also given the opportunity to provide commentary regarding their overall experiences with the Residential Appliance Efficiency Program and to recommend improvements to the program. Several respondents stated that they would have preferred the option to submit a rebate application online. A few respondents recommended increasing the rebate amounts, noting that the amount is small compared to the total price of the appliances. Additionally, three respondents suggested adding more appliances to the program so that a wider variety of rebates would be available.

As an alternative to program recommendations, many respondents used this opportunity to provide praise for the Appliance Program, citing their positive experiences. Specific comments of this nature include:

“SMUD was very helpful with explaining how upgrading my appliances would better my bill, and savings were great. Staff were friendly.”

“I got the check promptly, and [the application] was just easy.”

“The rebate helped me to save money and become energy efficient.”

“[I have] dealt with SMUD a long time and have a positive attitude toward them.”

“There were no problems, and everything was quick and effective.”

“I think having rebates encourages people to purchase energy efficient products and be able to purchase more high-end appliances.”

Overall, the survey findings indicate that participants of the Residential Appliance Efficiency Program are generally satisfied with their program experiences, and that they value the opportunity to receive rebates for the various program appliances.

5.4.8 Participant Demographics & Household Characteristics

Finally, participant survey respondents were asked a series of questions in order to gather information regarding their home characteristics and demographics. The results of these questions are displayed in the following tables and charts:

Table 57: Age of Participant Respondent Homes

| | Response | (n=222) | Percent of Respondents |
|---------------------------|---------------|---------|------------------------|
| When was your home built? | Before 1970's | 67 | 30% |
| | 1970's | 59 | 27% |
| | 1980's | 47 | 21% |
| | 1990-1994 | 20 | 9% |
| | 1995-1999 | 6 | 3% |
| | 2000-2005 | 10 | 5% |
| | 2006 or newer | 7 | 3% |
| | Don't know | 6 | 3% |

Table 58: Square Footage of Participant Respondent Homes

| | Response | (n=222) | Percent of Respondents |
|--|--------------------|---------|------------------------|
| What is the approximate square footage of your home? | Less than 1,000 | 12 | 5% |
| | 1,000-1,500 | 74 | 33% |
| | 1,501-2,000 | 68 | 31% |
| | 2,001-2,500 | 32 | 14% |
| | Greater than 2,500 | 24 | 11% |
| | Don't know | 9 | 4% |
| | Refused | 3 | 1% |

Figure 10: Number of Residents in Participant Respondent Homes

Including yourself, how many people currently live in your home year-round?

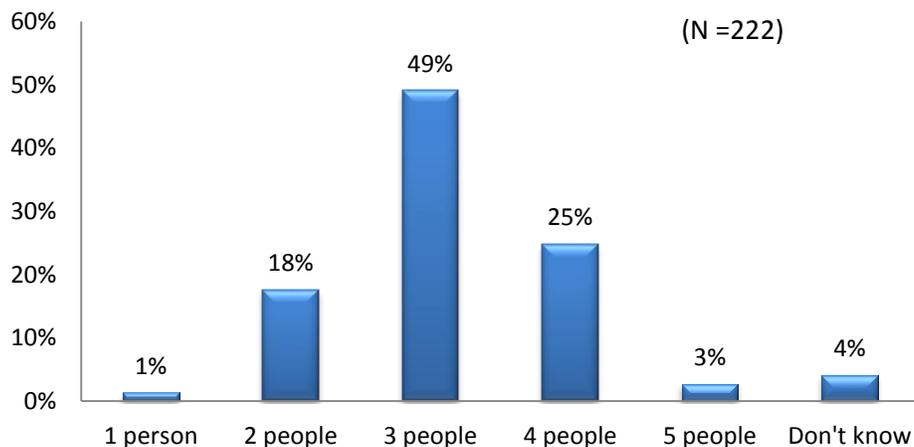


Figure 11: Number of Bedrooms in Participant Respondent Homes

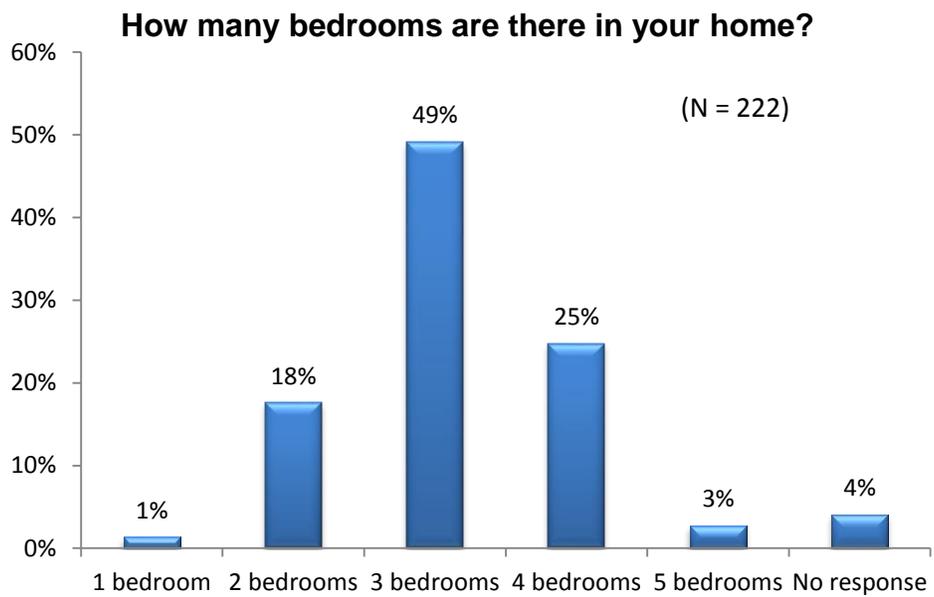


Figure 12: Number of Bathrooms in Participant Respondent Homes

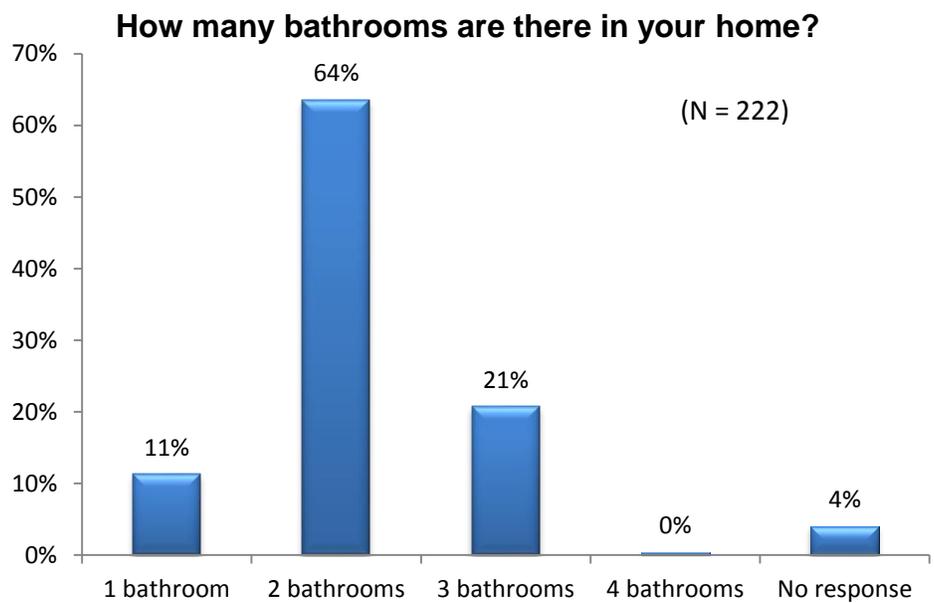


Table 59: Annual Income of Participant Respondent Households

| | <i>Response</i> | <i>(n=222)</i> | <i>Percent of Respondents</i> |
|---|------------------------|----------------|-------------------------------|
| Is the total annual income of your household: | Less than \$25,000 | 9 | 4% |
| | \$25,000 - \$35,000 | 12 | 5% |
| | \$36,000 - \$50,000 | 19 | 9% |
| | \$51,000 – \$75,000 | 26 | 12% |
| | \$76,000 - \$100,000 | 21 | 9% |
| | Greater than \$100,000 | 43 | 19% |
| | DK | 22 | 10% |
| | RF | 70 | 32% |

Table 60: Education Level of Participant Respondents

| | <i>Response</i> | <i>(n=222)</i> | <i>Percent of Respondents</i> |
|---|---|----------------|-------------------------------|
| What's the highest level of education you've completed? | Did not graduate high school | 2 | 1% |
| | High school graduate | 20 | 9% |
| | Associates degree, vocational/technical school, or some college | 55 | 25% |
| | Four-year college degree | 60 | 27% |
| | Graduate or professional degree | 63 | 28% |
| | DK | 3 | 1% |
| | RF | 19 | 9% |

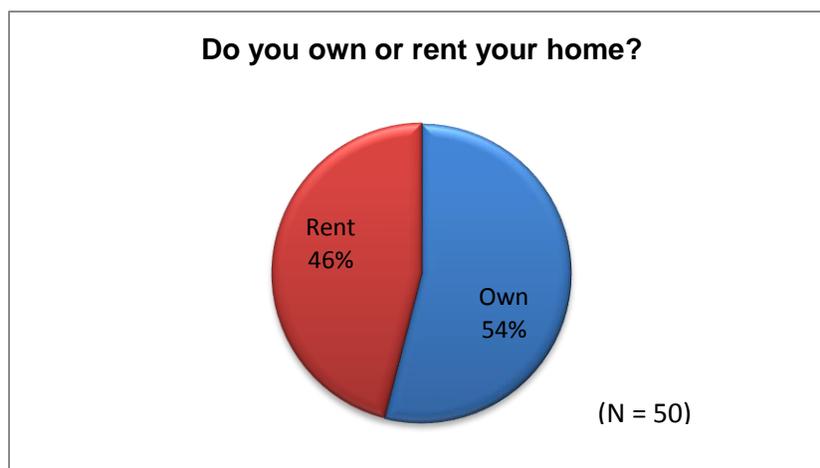
5.5 Non-participant Outcomes

In order to gain insight into existing participation barriers and compare program participant characteristics with non-participants, telephone surveys were conducted with a sample of customers who did not receive rebates through the Appliance Program. These customers were selected through simple random sampling, from a list provided by SMUD. The non-participant surveys specifically focus on customers' involvement with energy efficiency purchases, their awareness of available rebates and programs, and their potential future purchasing and program participation behaviors. In total, 50 non-participant SMUD customers responded to the telephone survey.

5.5.1 Non-participant Characteristics

Non-participant survey respondents were first asked whether they rent or own their home. As shown in Figure 13, responses were fairly evenly split with 54% of non-participants stating that they own their home.

Figure 13: Non-Participant Home Ownership



Next, non-participant respondents were asked whether they have gas or electric furnaces, water heaters, and dryers. Table 61 shows the distribution of responses. The majority of respondents (60%) reported having a gas furnace, and 64% of respondents stated that they have a gas tank style water heater. In contrast, nearly three-quarters (72%) of respondents reported having an electric clothes dryer.

Table 61: Fuel Type of Non-Participant Heating Equipment

| Measure Type | Fuel Type (n=50) | | | |
|-------------------------|------------------|-----|------------|----------------|
| | Electric | Gas | Don't know | Not applicable |
| Furnace | 26% | 60% | 8% | 6% |
| Tank style water heater | 10% | 64% | 12% | 14% |
| Tankless water heater | 8% | 48% | 14% | 30% |
| Clothes dryer | 72% | 12% | 8% | 8% |

It should be noted that 40% of respondents stated that they have both a tank style and a tankless water heater. As this is fairly uncommon, it is more likely that these respondents were not aware of their water heater type or did not understand the survey question. If the respondents who reported having both styles of water heater are removed from the calculations, 10% of respondents reported having an electric tank style water heater while 46% of respondents reported having a gas tank style water heater. Similarly under these conditions, 3% of respondents reported having an electric tankless water heater while 23% of respondents reported having a gas tankless water heater.

5.5.2 Non-participant Purchasing Activity

In order to gain insight into the decision making and purchasing behavior of non-participants, respondents were asked whether they had replaced one or more of a list of

appliances within the past three years. As shown in Table 62, the majority of respondents (54%) did not report purchasing any of the listed appliances. However, some respondents reported that they had purchased multiple appliances. The most commonly reported appliance purchases were clothes washers and refrigerators, each mentioned by 22% of respondents. Only one respondent reported purchasing a room air conditioner, although seven respondents stated that they had purchased a central air conditioner system.

Table 62: Non-Participant Appliances Previously Purchased

| In the last three years, while living in your current residence, have you purchased or replaced any of the following: | Response | (n=50) | Percent of Respondents Indicating 'Yes' |
|---|-------------------------|----------------|---|
| | | Clothes washer | 11 |
| | Refrigerator | 11 | 22% |
| | Dishwasher | 8 | 16% |
| | Central air conditioner | 7 | 14% |
| | Freezer | 3 | 6% |
| | Room air conditioner | 1 | 2% |
| | Other | 1 | 2% |
| | None/Don't know | 27 | 54% |

As a follow-up question, respondents who reported purchasing one or more of the listed appliances were asked whether these appliances were ENERGY STAR® certified. As shown in Table 63, the majority of clothes washers, refrigerators, dishwashers, and freezers were reported to be ENERGY STAR® certified models. These results suggest that non-participant customers are fairly actively purchasing new or replacement appliances, and that these new appliances are likely to be ENERGY STAR® units.

Table 63: Energy Efficiency of Non-Participant Prior Appliance Purchases

| Was the [Measure] ENERGY STAR®? | Response | Percent of Respondents Indicating 'Yes' | N |
|---------------------------------|-------------------------|---|-----|
| | | Clothes washer | 73% |
| | Refrigerator | 55% | 11 |
| | Dishwasher | 63% | 8 |
| | Central air conditioner | 29% | 7 |
| | Freezer | 66% | 3 |
| | Room air conditioner | 0% | 1 |

5.5.3 SMUD Program Awareness

In order to assess non-participant program awareness and program marketing channels, non-participant survey respondents were asked whether they had heard about any of the energy efficiency rebate programs offered by SMUD. Table 64

indicates that the majority of respondents (54%) had heard about at least one SMUD rebate program.

Table 64: Overall Non-Participant Rebate Awareness

| Have you heard about any of the energy efficiency rebate programs offered by SMUD, for the purchase of energy efficient appliances and equipment? | <i>Response</i> | <i>(n=50)</i> | <i>Percent of Respondents</i> |
|---|-----------------|---------------|-------------------------------|
| | Yes | 27 | 54% |
| | No | 21 | 42% |
| | DK | 2 | 4% |
| | RF | 0 | 0% |

When asked which programs they had heard about, these respondents most commonly stated that they were aware of the overall Residential Appliance Efficiency Program, and many of these respondents indicated that they specifically knew about the available refrigerator, dishwasher, and room air conditioner rebates. Fewer respondents specifically stated that they had heard about the clothes washer rebate component of the Residential Appliance Efficiency Program.

Table 65: Non-Participant Awareness of Specific Rebates

| Which SMUD rebates have you heard about? | <i>Response</i> | <i>(n=27)</i> | <i>Percent of Respondents</i> |
|--|--|---------------|-------------------------------|
| | Overall Residential Appliance Efficiency | 16 | 59% |
| | Refrigerator rebates | 11 | 41% |
| | Dishwasher rebates | 8 | 30% |
| | Room air conditioner rebates | 7 | 26% |
| | Clothes washer rebates | 4 | 15% |
| | Other | 2 | 7% |
| | Don't know | 3 | 11% |

Respondents who identified specific SMUD rebate program opportunities were then asked how they had learned about these programs. As shown in Table 66, these respondents most commonly stated that they had heard about the programs through SMUD bill inserts. Nineteen percent of these respondents stated that they learned about the programs through the SMUD website, which contains information about program requirements and eligible appliance types. Although many of the non-participant respondents had recently purchased one or more energy efficient appliances, only 15% of these respondents reported that they had learned about the SMUD programs through a retail store. This may be due to customers shopping at stores that do not actively promote SMUD rebates or purchasing appliances online and simply picking them up in-store. Alternatively, customers may have learned about the SMUD rebates through another method prior to entering the retail store and making their appliance purchase.

Table 66: Non-Participant Method of Rebate Program Awareness

| | <i>Response</i> | <i>(n=27)</i> | <i>Percent of Respondents</i> |
|--|------------------|---------------|-------------------------------|
| Could you tell me how you heard about the rebates you mentioned? | SMUD Bill Insert | 12 | 44% |
| | SMUD website | 5 | 19% |
| | Retail Store | 4 | 15% |
| | Contractor | 4 | 15% |
| | Print Ad | 3 | 11% |
| | Radio | 3 | 11% |
| | Word-of-Mouth | 2 | 7% |

Non-participant respondents who reported being aware of one or more SMUD rebates were then asked whether they had ever participated in a SMUD energy efficiency rebate program. The majority (70%) of these respondents stated that they had not participated in such a program, while the remaining 30% confirmed that they had previously participated.

The respondents who stated that they had purchased an appliance in the past three years, that they were currently aware of SMUD rebates, and that they had never participated in a SMUD rebate program were asked why they had not participated. As shown in Table 67, the majority of these respondents (53%) stated that they had not been aware of the available rebates at the time of purchase. This suggests that the existing program marketing channels may have been effective in reaching these respondents, but that the information arrived too late to be incorporated into the respondents' decision making.

Table 67: Reasons for Not Applying for Incentives

| | <i>Response</i> | <i>(n=19)</i> | <i>Percent of Respondents</i> |
|---|---|---------------|-------------------------------|
| Why didn't you apply for an incentive through SMUD for the equipment you mentioned replacing in the past three years? | Didn't know about available programs | 10 | 53% |
| | Equipment didn't qualify for SMUD | 1 | 5% |
| | Too much paperwork | 0 | 0% |
| | Intended to receive incentive, but forgot | 1 | 5% |
| | Other | 4 | 21% |
| | DK | 3 | 16% |
| | RF | 0 | 0% |

The next section of the survey was administered to respondents who stated that they were not aware of any SMUD rebate programs. These questions were designed to assess potential barriers to participation, as well as overall customer preferences regarding energy efficiency.

Respondents who indicated that they were not aware of any SMUD rebate programs were given the following explanation:

“SMUD offers incentives to purchase more efficient clothes washers, refrigerators, room air conditioners, and dishwashers, to help you reduce your overall energy usage and save money on utility bills.”

Following this explanation, these respondents were asked about their likelihood of participating in a SMUD energy efficiency program within the next year. As shown in Table 68, 24% of these respondents reported that they were very likely or somewhat likely to participate in one or more SMUD programs. More than one-third (38%) of respondents indicated that they were somewhat unlikely or very unlikely to participate within the next year, while the remaining respondents provided neutral or “don’t know” responses.

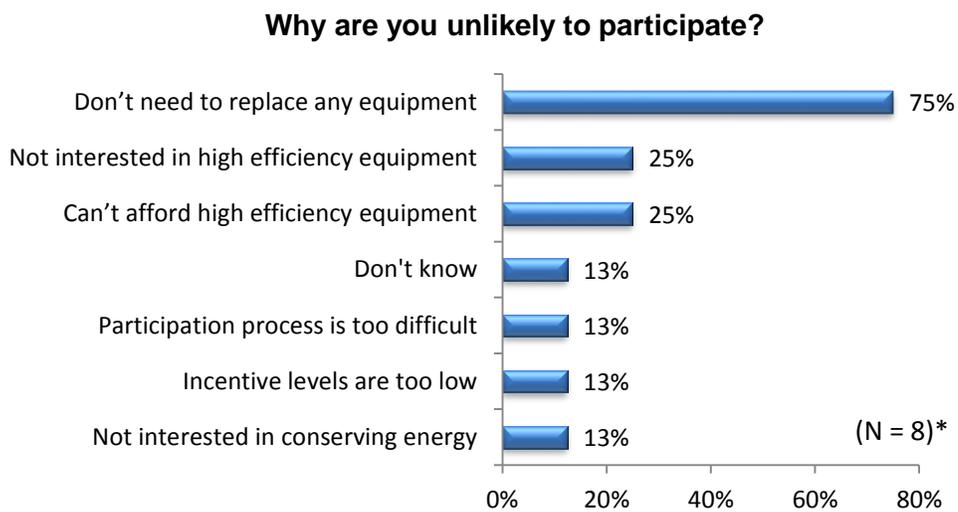
Table 68: Non-Participant Likelihood of SMUD Program Participation

| | <i>Response</i> | <i>(n=21)</i> | <i>Percent of Respondents</i> |
|--|-----------------------------|---------------|-------------------------------|
| How likely are you to participate in a SMUD energy efficiency program within the next year? Would you say you are... | Very likely | 4 | 19% |
| | Somewhat likely | 1 | 5% |
| | Neither likely nor unlikely | 5 | 24% |
| | Somewhat unlikely | 1 | 5% |
| | Very unlikely | 7 | 33% |
| | DK | 3 | 14% |
| | RF | 0 | 0% |

The eight respondents who stated that they were somewhat or very unlikely to participate in a SMUD program were asked to identify all of the factors contributing to this statement. The most common response, and the response that is likely a primary barrier to participation, was that the respondent does not need to replace any of their equipment. Additionally, two respondents stated that they are not interested in high efficiency equipment while another two respondents stated that they cannot afford high efficiency equipment. Only one respondent reported that the participation process is too difficult, that the incentive levels are too low, or that they are not interested in conserving energy.

These results suggest that while there appear to be multiple barriers to participation for existing non-participants, the most common issue is that a substantial portion of this group is not planning to make a qualifying equipment purchase in the near future. Overall, the majority of respondents are currently aware of at least one SMUD rebate opportunity, although they may not have been aware of the rebates at the time of their most recent appliance purchase. Additionally, approximately one-quarter of all non-participant respondents reported that they have participated, or are likely to participate, in a SMUD rebate program.

Figure 14: Reported Non-Participant Barriers to Participation



*Respondents were able to select multiple responses. The percentages shown are percentages of respondents rather than percentages of responses. Thus, the total exceeds 100%.

The following sections present survey results for questions related to specific measure types. These questions were asked in order to gain insight into non-participants' existing appliances, and to address the market potential for ENERGY STAR® equipment and SMUD rebates.

5.5.4 Non-participant Clothes Washers

Eighty percent of the non-participant respondents reported that they currently own a clothes washer. When asked about the age of their existing clothes washer, 38% of these respondents reported that their clothes washer is at least six years old. Only five percent of respondents indicated that their existing clothes washer is less than one year old.

Table 69: Reported Age of Non-Participant Respondent Clothes Washers

| | <i>Response</i> | <i>(n=40)</i> | <i>Percent of Respondents</i> |
|---|------------------------|---------------|-------------------------------|
| How old is your current clothes washer? | Less than a year old | 2 | 5% |
| | 1-2 years old | 5 | 13% |
| | 3-5 years old | 12 | 30% |
| | 6-10 years old | 11 | 28% |
| | More than 10 years old | 4 | 10% |
| | DK | 6 | 15% |
| | Refused | 0 | 0% |

In terms of energy efficiency, more than half (55%) of the respondents who reported owning a clothes washer stated that it was an energy efficient (ENERGY STAR®)

model. Twenty-one percent of respondents did not know whether their clothes washer was energy efficient, and one-quarter of respondents stated that their clothes washer is not an energy efficient model.

When asked if they planned to replace their clothes washer with a newer model in the next two years, only one of the non-participant respondents stated that they were planning to do this. This respondent was not sure when exactly they would replace their clothes washer, but stated that the new unit would be ENERGY STAR® certified.

5.5.5 Refrigerators

Non-participant respondents were then asked to indicate the number of refrigerators that they have in their home. Three-quarters of respondents reported having one refrigerator, while 20% of respondents stated that they have two refrigerators. Two respondents (4%) reported that they do not own a refrigerator (renters). Respondents who indicated that they owned at least one refrigerator were asked a series of questions about their primary refrigerator (i.e. the refrigerator used most often).

As shown in Table 70, 27% of these respondents reported that their refrigerator is at least six years old, and 29% stated that it is three to five years old.

Table 70: Reported Age of Non-Participant Respondent Refrigerators

| | <i>Response</i> | <i>(n=48)</i> | <i>Percent of Respondents</i> |
|---|----------------------|---------------|-------------------------------|
| How old is your current primary refrigerator? | Less than a year old | 2 | 4% |
| | 1-2 years old | 7 | 15% |
| | 3-5 years old | 14 | 29% |
| | 6-10 years old | 8 | 17% |
| | More than 10 years | 5 | 10% |
| | DK | 12 | 25% |
| | RF | 0 | 0% |

Half of the respondents who currently own a refrigerator stated that it is an ENERGY STAR® model, while 27% indicated that it is not. The remaining 23% of respondents did not know the energy efficiency classification of their existing refrigerator.

When asked if they planned to replace their refrigerator with a newer model in the next two years, only one of the non-participant respondents stated that they were planning to do this. This respondent explained that they are planning to replace the refrigerator within six months to a year, and that the new unit would be ENERGY STAR® certified.

5.5.6 Air Conditioners

When asked, only four (8%) of the non-participant responses reported that they currently own a room air conditioner. When asked to identify the age of their existing air conditioner, two of the four respondents stated that the unit was less than a year old,

while the third respondent stated that their unit was more than 10 years old. The remaining respondent did not know the age of their unit. In terms of energy efficiency, only one of the respondents stated that their air conditioner was ENERGY STAR® certified; this was one of the respondents who had identified their air conditioner as less than a year old.

None of the respondents who currently own room air conditioners stated that they were planning to replace these units within the next two years.

5.5.7 Dishwashers

Approximately three-quarters (74%) of non-participant respondents indicated that they currently own a dishwasher. As shown in Table 71, 36% of these dishwashers were reported to be at least six years old, while 30% were reported to be two years old or less. According to these findings, dishwashers owned by non-participants are older on average than refrigerators and clothes washers.

Table 71: Reported Age of Non-Participant Respondent Dishwashers

| | <i>Response</i> | <i>(n=37)</i> | <i>Percent of Respondents</i> |
|-------------------------------------|------------------------|---------------|-------------------------------|
| How old is your current dishwasher? | Less than a year old | 6 | 16% |
| | 1-2 years old | 5 | 14% |
| | 3-5 years old | 7 | 19% |
| | 6-10 years old | 8 | 22% |
| | More than 10 years old | 5 | 14% |
| | DK | 6 | 16% |
| | RF | 0 | 0% |

When asked whether their current dishwasher is energy efficient, more than half (57%) of these respondents stated that they currently own an ENERGY STAR® model. As with the other measures, a substantial percentage of respondents (22%) reported that they did not know the efficiency level of their dishwasher. The remaining 21% of respondents indicated that their existing dishwasher is not energy efficient.

Only two of the respondents who currently own a dishwasher indicated that they planned to purchase a newer model within the next two years. Both of these respondents reported that the replacement would occur within six months to a year, and one indicated that the new unit would be ENERGY STAR® certified. The remaining respondent stated that they were not sure whether the new model would be energy efficient, but that it would be a high-end model.

5.5.8 Non-participant Demographics & Household Characteristics

Finally, non-participant survey respondents were asked a series of questions in order to gather information regarding their home characteristics and demographics. These

questions are identical to those asked of participant survey respondents. The results of these questions are displayed in the following tables and charts:

Table 72: Reported Age of Non-Participant Respondent Homes

| | <i>Response</i> | <i>(n=50)</i> | <i>Percent of Respondents</i> |
|---------------------------|-----------------|---------------|-------------------------------|
| When was your home built? | Before 1970's | 18 | 36% |
| | 1970's | 4 | 8% |
| | 1980's | 4 | 8% |
| | 1990-1994 | 3 | 6% |
| | 1995-1999 | 3 | 6% |
| | 2000-2005 | 4 | 8% |
| | 2006 or newer | 2 | 4% |
| | Don't know | 12 | 24% |

Table 73: Square Footage of Non-Participant Respondent Homes

| | <i>Response</i> | <i>(n=50)</i> | <i>Percent of Respondents</i> |
|--|-----------------|---------------|-------------------------------|
| What is the approximate square footage of your home? | Less than 1,000 | 5 | 10% |
| | 1,000-1,500 | 13 | 26% |
| | 1,501-2,000 | 11 | 22% |
| | 2,001-2,500 | 1 | 2% |
| | Greater than | 8 | 16% |
| | Don't know | 12 | 24% |
| | Refused | 0 | 1% |

Figure 15: Number of Residents in Non-Participant Respondent Homes

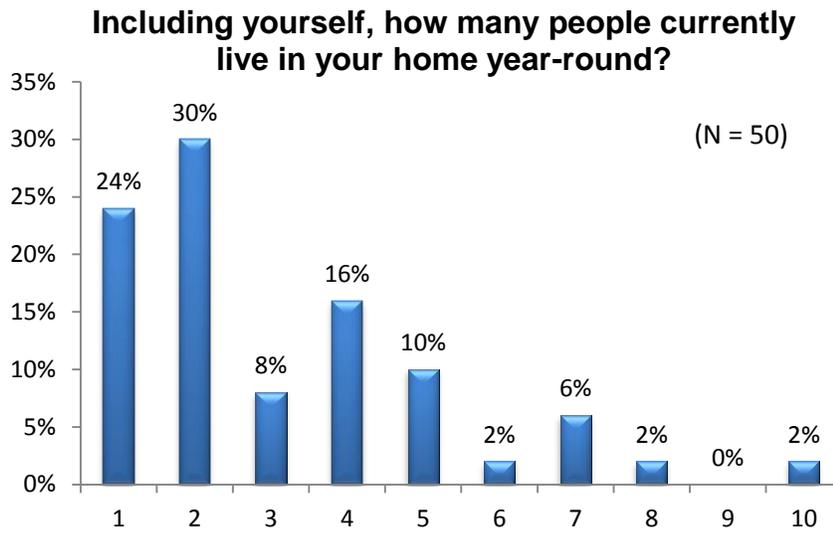


Figure 16: Number of Bedrooms in Non-Participant Respondent Homes



Figure 17: Number of Bathrooms in Non-Participant Respondent Homes

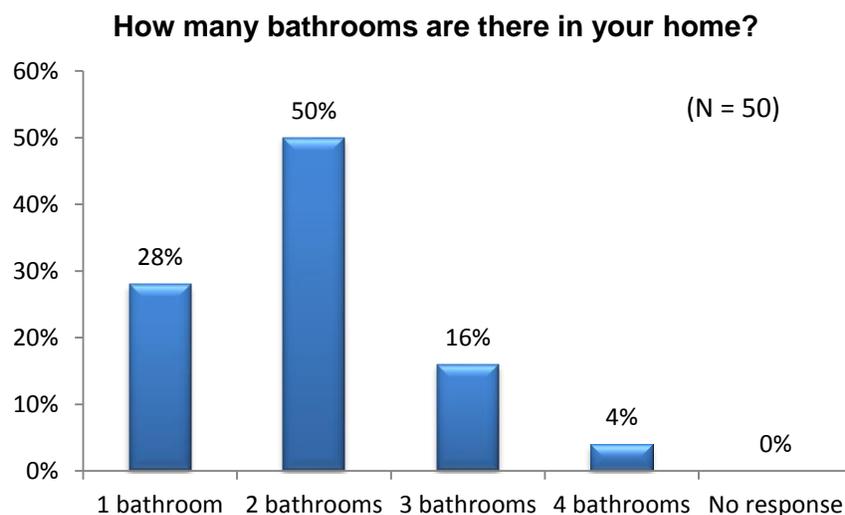


Table 74: Income Level of Non-Participant Respondent Households

| | Response | (n=50) | Percent of Respondents |
|---|------------------------|--------|------------------------|
| Is the total annual income of your household: | Less than \$25,000 | 9 | 18% |
| | \$25,000 - \$35,000 | 4 | 8% |
| | \$36,000 - \$50,000 | 7 | 14% |
| | \$51,000 - \$75,000 | 4 | 8% |
| | \$76,000 - \$100,000 | 6 | 12% |
| | Greater than \$100,000 | 4 | 8% |
| | DK | 2 | 4% |
| | RF | 14 | 28% |

Table 75: Education Level of Non-Participant Respondents

| | Response | (n=50) | Percent of Respondents |
|---|---------------------------------|--------|------------------------|
| What's the highest level of education you've completed? | Did not graduate high school | 2 | 4% |
| | High school graduate | 5 | 10% |
| | Associates degree, | 19 | 38% |
| | Four-year college degree | 12 | 24% |
| | Graduate or professional degree | 7 | 14% |
| | DK | 0 | 0% |
| | RF | 5 | 10% |

5.6 Residential Field Visit Survey

ADM conducted onsite visits to a sub-sample of residences owned by respondents to the participant survey. The purpose of these visits was primarily to conduct verification and metering on residential appliances for the purposes of informing the program impact evaluation. Additionally, field engineers administered a short survey in order to gather customer data regarding their existing appliances and program awareness. In total, 15 onsite visit participants responded to this field survey. This section summarizes the survey results.

Onsite field visit respondents were first asked whether they were the primary decision maker for equipment purchasing decisions within their households. All but one respondent reported that they were the primary decision maker.

The following table displays the distribution of appliance types for the onsite field visits.

Table 76: Distribution of Appliance Types, Home Visits

| <i>Measure Type</i> | <i>(n=15)</i> | <i>Percentage of Total</i> |
|----------------------|---------------|----------------------------|
| Clothes washer | 6 | 40% |
| Refrigerator | 5 | 33% |
| Room air conditioner | 1 | 7% |
| Dishwasher | 3 | 20% |

Respondents were asked to identify their specific reasons for choosing the particular model of appliance that they purchased. Customers were able to provide more than one response to this question, and the following table displays the distribution of responses. Respondents most commonly stated that price, energy efficiency, and brand were their main reasons for selecting the particular model of appliance. Additional reasons included the specific features of the model and the look or style of the model.

Table 77: Primary Factors for Appliance Selection, Home Visit Respondents

| <i>Measure Type</i> | <i>(n=15)</i> | <i>Percentage of Respondents</i> |
|---------------------|---------------|----------------------------------|
| Price | 6 | 40% |
| Energy | 6 | 40% |
| Brand | 5 | 33% |
| Features | 4 | 27% |
| Style | 3 | 20% |
| Don't know | 2 | 13% |

In order to gauge overall program awareness, respondents were asked whether they were aware of the available SMUD rebates prior to purchasing their ENERGY STAR® appliance. Eighty percent of home visit respondents stated that they were aware of the SMUD rebates prior to the point of purchase, while the remaining respondents stated that they had not been previously aware.

These remaining respondents were then asked how they learned about the rebates, and all three of them stated that they had learned about the rebates within the retail store where they purchased the appliance. These results support findings from the participant survey, which suggested that a substantial portion of participants first learn about the Residential Appliance Efficiency Program at the time they are purchasing their equipment.

6. Market Characterization and Other Key Findings

This chapter presents the results of the market potential analysis along with other key findings resulting from the evaluation effort.

6.1 Market Scan

ADM conducted a cursory market scan to identify upcoming trends and changes within the energy efficient appliance market and modifications to ENERGY STAR® specifications. This was intended to provide insight into external factors that may affect the Residential Appliance Energy Efficiency Program. The market scan consisted of online research conducted at the ENERGY STAR® website (www.energystar.gov), through energy efficiency press releases and other relevant industry communications.

Much of the information obtained through this market scan was used to estimate future appliance purchases within the Sacramento area. Thus, this section summarizes additional findings from the market scan that may be useful for future program planning and design purposes.

A webinar conducted in January of 2014 by a member of the U.S. Environmental Protection Agency (EPA) addressed upcoming specification updates within the ENERGY STAR® appliances group.¹⁶ This webinar discussed each of the measure types that were rebated through the Residential Appliance Energy Efficiency Program, as well as additional details regarding emerging appliances. The highlights of the webinar, as relevant to the Residential Appliance Energy Efficiency Program, are as follows:

Refrigerators & Freezers

ENERGY STAR® market penetration for refrigerators and freezers exceeded 75% in 2012, and many current refrigerators exceed ENERGY STAR® requirements by up to 18%. New 2014 specifications require refrigerators and freezers to use 30-40% less energy than current conventional models in order to be classified as ENERGY STAR® units (effective September 15, 2014).

Clothes Washers

ENERGY STAR® market penetration for clothes washers exceeded 60% in recent years and many currently available units exceed ENERGY STAR® criteria. Proposed update to clothes washers, for 2015, includes requiring a Modified Energy Factor (MEF)

¹⁶ Obtained online from the Energy Star® website:
http://www.energystar.gov/ia/partners/downloads/ENERGY_STAR_Appliance_Specification_Updates_Webinar.pdf

of 2.5 or greater for top load units and a MEF of 2.8 or greater for front load units. This is expected to save 20-30% on clothes washer energy use and 20-50% on water use.

Room Air Conditioners

ENERGY STAR® market penetration for room air conditioners exceeded 50% in recent years, and over 7 million room air conditioners were sold in 2012. Effective October 1, 2013, new room air conditioner specifications require ENERGY STAR® units to be 15% more efficient than current conventional models. Additionally, new certified models will have advanced features such as a filter change reminder and a default energy saver mode. These specifications are expected to save 90 kWh per year on average per unit.

Dishwashers

ENERGY STAR® market penetration for residential dishwashers was 89% in 2012. The EPA has developed updated standards for dishwashers that will be released in early 2014. Among other details, these standards will include updated energy usage and water usage criteria for dishwashers. Further details will be available upon release of the updated standards.

Emerging Product: Clothes Dryers

The EPA began developing specifications for ENERGY STAR® clothes dryers in 2012, and the first clothes dryer was given the “EPA Emerging Technology Award” in 2013. Following this, emerging technology criteria for clothes dryers were developed for 2014. ENERGY STAR® specification for clothes dryers will require a maximum drying cycle time of 80 minutes. The energy usage for qualifying clothes dryers is expected to be 20% less than current conventional models. The effective date of this new specification is proposed for January 2015.

- From the webinar document: “[Clothes dryers are the] largest residential end-use load for which there are no voluntary or mandatory labeling programs.”

ENERGY STAR® Most Efficient

This program is designed to classify certain equipment models as the most efficient units in their measure category. Criteria to meet ENERGY STAR® Most Efficient are stricter than general ENERGY STAR® classification, and qualifying equipment must exceed the energy savings of standard ENERGY STAR® units. For home appliances (such as those qualifying for the Residential Appliance Energy Efficiency Program), the 2014 criteria for meeting ENERGY STAR® Most Efficient classification are identical to 2013 criteria.

Connected Functionality

ENERGY STAR® specification is currently developing standards to incorporate “Connected” product features. This involves features such as smart grid connectivity of appliances for the purpose of demand response savings and other energy efficiency benefits. Thus far, specifications have been developed for residential refrigerators and freezers, and specifications are currently being considered for clothes washers, room air conditioners, dishwashers, clothes dryers, and other equipment types. This is expected to further increase appliance energy savings, and to provide demand response benefits to specific measure types.

Overall, these results suggest that there are several upcoming modifications to ENERGY STAR® specifications that may affect the Residential Appliance Energy Efficiency Program. Primarily, these changes are related to incrementally increasing the energy efficiency requirements for various appliance types, which is in response to shifting baseline efficiency for most end-uses. ENERGY STAR® criteria have been continually updated throughout the years in order to account for market transformation effects and technological advancements, and these types of updates are expected to continue in the future. SMUD program requirements should remain current with updated ENERGY STAR® criteria, and it may be beneficial to consider adding energy efficient clothes dryers to program rebate offerings once the ENERGY STAR® specifications are fully in place.

6.2 Market Potential for Program Appliances in Future Years

An estimate of the current population of residential accounts for the Sacramento region as of July 2013 was provided by SMUD (539,069) and used along with customer survey data to estimate the number of appliances in each category that are likely to be sold within the next two years.

6.2.1 Clothes Washers

ADM used the results of the program participant and non-participant SMUD customer survey to estimate the saturation rate for clothes washers. This involved combining the reported clothes washer saturation rates for the following two groups:

- Program participants who had not received a clothes washer rebate through the program; and
- Program non-participant homeowners.

Out of the 222 participants surveyed, 179 had received a clothes washer rebate through the Residential Appliance Efficiency Program. Twelve percent of the remaining respondents reported that they did not own a clothes washer. In the non-participant survey, all but 3.7% of homeowners stated that they own a clothes washer. Combining these results, the estimated average number of clothes washers per household rounds to .91. Multiplying the estimated number of clothes washers per household by the

number of SMUD residential accounts produces an estimate of clothes washers currently in residential use in the Sacramento region. This number is 490,553 clothes washers.

The Database for Energy Efficient Resources (DEER) estimates the expected useful life of a clothes washer to be approximately 11 years.¹⁷ If one in every 11 clothes washers in SMUD residential households is replaced over the next year, that would be approximately 45,000 clothes washers, or about 89,000 clothes washers over the next two years.¹⁸ To check the reasonableness of this estimate, ADM developed two alternate estimates of clothes washer sales over the next two years.

The 2010 U.S. Census estimated that there are approximately 116.7 million households in the U.S.¹⁹ SMUD's residential population of 539,069 households makes up 0.46% of that value. ENERGY STAR® shipment data from 2010 through 2012 show shipment quantities of 5,144,000, 4,625,000, and 4,856,000 ENERGY STAR® clothes washers, respectively.²⁰ By referencing the market penetration data for ENERGY STAR® units, it is possible to estimate the total units shipped, both ENERGY STAR® and non-ENERGY STAR® qualified. For 2010-2012, this results in estimated total shipment of 8,037,500, 7,581,967, and 7,357,576 clothes washers, respectively.

The Association of Home Appliance Manufacturers (AHAM) estimated an increase of 6.6% in total appliance demand in 2013, followed by another 7% demand increase in 2014.²¹ Multiplying these forecasts by the 2012 ENERGY STAR® shipment data results in an approximate estimate of 8,392,000 total clothes washers shipped in 2014.

If 0.46% of these units are shipped and sold to SMUD residential households, that's roughly 39,000 clothes washers in 2014 or, applying the 2014 demand increase to 2015, roughly 80,000 clothes washers in 2014-2015.

ADM also asked survey respondents if they are planning to purchase a clothes washer within the next two years. Figure 18 shows respondents' replies. This figure includes responses from program participants who did not receive a clothes washer rebate through the program, and from non-participant homeowners.

¹⁷ Obtained from the Database for Energy Efficient Resources (DEER): <http://www.deeresources.com/>

¹⁸ For the purposes of approximation, market potential estimates are rounded to the nearest thousand.

¹⁹ <http://www.census.gov/prod/cen2010/briefs/c2010br-14.pdf>

²⁰ Obtained from 2010, 2011, and 2012 Unit Shipment Data reports: www.energystar.gov

²¹ Association of Home Appliance Manufacturers (AHAM), AMUSA forecast, Sept 2013

Figure 18: Future Planning to Purchase Clothes Washers



As Figure 18 shows, only 4% of respondents indicated they are likely to purchase a new clothes washer within the next two years. The 2010 Census estimated that Sacramento County has a population of 1,055,578 people above the age of 18.²² If 4% of these people were to purchase a clothes washer over the next two years, that would be approximately 42,000 clothes washers sold. This is significantly less than the estimates obtained through the other two methods.

Averaging the three forecasted values (89,000, 80,000, and 42,000) results in an estimate of 70,000 residential clothes washers sold to SMUD customers in 2014-2015. ENERGY STAR® market penetration data for clothes washers indicates that in 2012, ENERGY STAR® residential clothes washers had a market penetration level of 66%. Applying this market penetration value to the two-year forecast suggests that approximately 46,000 ENERGY STAR® clothes washers will be sold to SMUD customers within the next two years.

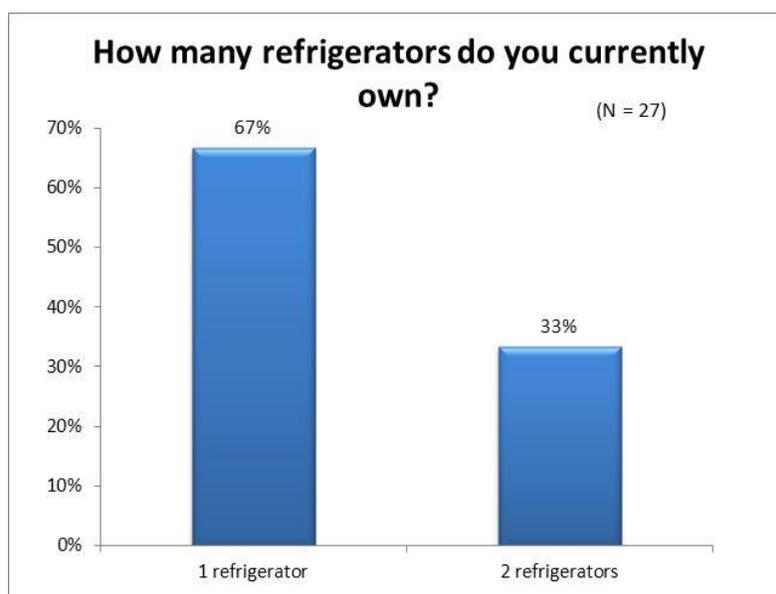
6.2.2 Refrigerators

ADM used the results of the non-participant SMUD customer survey to estimate the saturation rate for refrigerators. Non-participant homeowners were asked how many refrigerators they own, with results presented below.

²² <http://quickfacts.census.gov/qfd/states/06/06067.html>

²² Note: the population of Sacramento County is used as a proxy for the number of people living in residential homes serviced by SMUD.

Figure 19: Number of Refrigerators Owned, Non-participant Homeowners



This totaled 36 refrigerators, or approximately 1.33 refrigerators on average per household. Multiplying the estimated number of refrigerators per household by the number of SMUD residential accounts produces an estimate of refrigerators currently in residential use in the Sacramento region. This number is 718,741 refrigerators.

A 2011 study by the Lawrence Berkeley National Laboratory regarding lifetimes of residential appliances found the mean lifetime of residential refrigerators to be 19.8 years.²³ If one in every 19.8 refrigerators in SMUD residential households is replaced over the next year, that would be 36,300 refrigerators, or about 73,000 refrigerators over the next two years. To check the reasonableness of this estimate, ADM developed two alternate estimates of refrigerator sales over the next two years.

The 2010 U.S. Census estimated that there are approximately 116.7 million households in the U.S.²⁴ SMUD's residential population of 539,069 households makes up 0.46% of that value. ENERGY STAR® shipment data from 2010 through 2012 show shipment quantities of 4,684,000, 5,008,000, and 6,585,000 ENERGY STAR® refrigerators, respectively. By referencing the market penetration data for ENERGY STAR® units, it is possible to estimate the total units shipped, both ENERGY STAR® and non-ENERGY STAR® qualified. For 2010-2012, this results in estimated total shipment of 9,368,000, 8,942,850, and 8,664,473 refrigerators, respectively.

The Association of Home Appliance Manufacturers (AHAM) estimated an increase of 6.6% in total appliance demand in 2013, followed by another 7% demand increase in

²³ <http://escholarship.org/uc/item/3kq4908x#page-10>

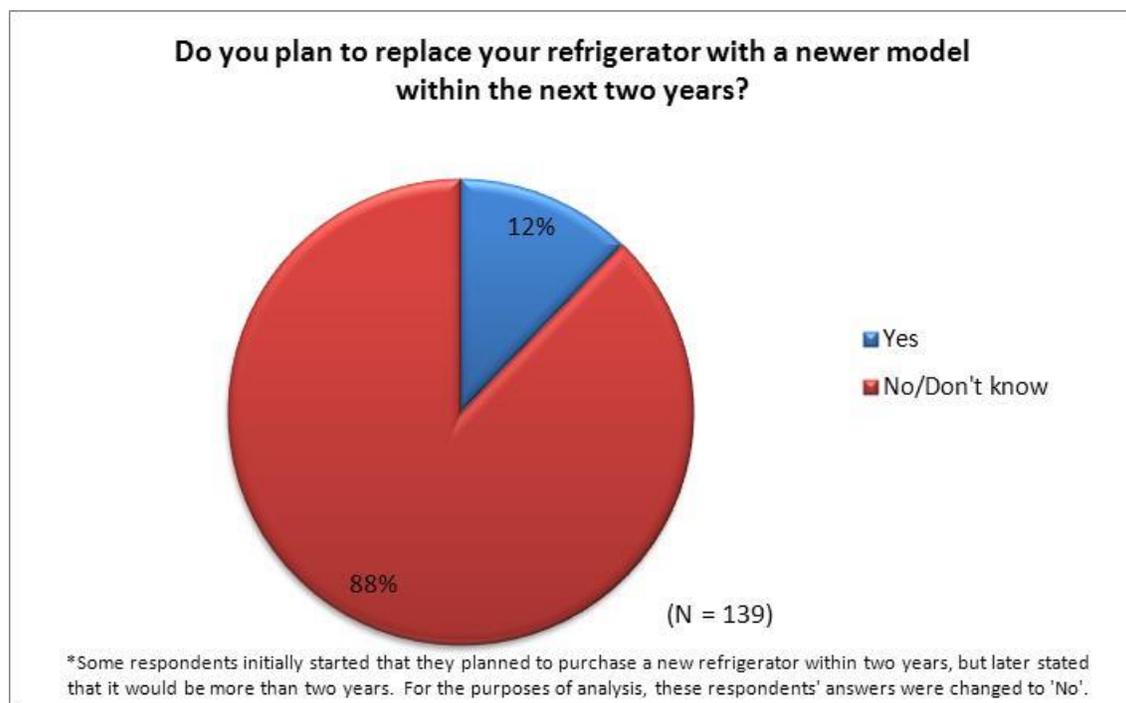
²⁴ <http://www.census.gov/prod/cen2010/briefs/c2010br-14.pdf>

2014. Multiplying these forecasts by the 2012 ENERGY STAR® shipment data results in an estimated 9,883,000 total refrigerators shipped in 2014.

If 0.46% of these units are shipped and sold to SMUD residential households, that's roughly 45,000 refrigerators in 2014 or, applying the 2014 demand increase to 2015, roughly 94,000 refrigerators in 2014-2015.

ADM also asked survey respondents if they are planning to purchase a refrigerator within the next two years. Figure 20 shows respondents' replies. This figure includes responses from program participants who did not receive a refrigerator rebate through the program, and from non-participant homeowners.

Figure 20: Future Planning to Purchase Refrigerators



As Figure 20 shows, 12% of respondents indicated they are likely to purchase a new refrigerator within the next two years. The 2010 Census estimated that Sacramento County has a population of 1,055,578 people above the age of 18.25. If 16% of these people were to purchase a refrigerator over the next two years, that would be 129,000 refrigerators sold.

There is a substantial variation among the three estimates obtained, which may be due to regional vs. national trends, response biases, or uncertainties within market data. Averaging the three forecasted values (73,000, 94,000, and 129,000) results in an

²⁵ <http://quickfacts.census.gov/qfd/states/06/06067.html>

²⁵ Note: the population of Sacramento County is used as a proxy for the number of people living in residential homes serviced by SMUD.

estimate of 99,000 residential refrigerators sold to SMUD customers in 2014-2015. ENERGY STAR® market penetration values for refrigerators indicate that in 2012, ENERGY STAR® residential refrigerators had a market penetration level of 76%. Applying this market penetration value to the two-year forecast suggests that approximately 75,000 ENERGY STAR® refrigerators will be sold to SMUD customers within the next two years.

6.2.3 Room Air Conditioners

ADM used the results of the program participant and non-participant SMUD customer survey to estimate the saturation rate for room air conditioners. This involved combining the reported clothes washer saturation rates for the following two groups:

- Program participants who had not received a room air conditioner rebate through the program; and
- Program non-participant homeowners.

Out of the 222 participants surveyed, 44 had received a room air conditioner rebate through the Residential Appliance Efficiency Program. Only 14% of the remaining respondents reported that they owned a room air conditioner. In the non-participant survey, only 8% of respondents reported that they own a room air conditioner. Combining these results, the estimated average number of room air conditioners per household rounds to .13. Multiplying the estimated number of room air conditioners per household by the number of SMUD residential accounts produces an estimate of room air conditioners currently in residential use in the Sacramento region. This number is approximately 71,000 room air conditioners.

A 2011 study by the Lawrence Berkeley National Laboratory regarding lifetimes of residential appliances found the mean lifetime of room air conditioners to be 12.9 years.²⁶ If one in every 12.9 room air conditioners in SMUD residential households is replaced over the next year, that would be about 6,000 room air conditioners, or 11,000 room air conditioners over the next two years. As this value only relates to measure replacement, and the saturation rate for this measure is low, this value likely underestimates the actual number of room air conditioners that will be purchased. The participant survey results suggest that approximately 28% of purchased room air conditioners are not replacements, although this number may be greater in the broad customer population. To check the reasonableness of this estimate, ADM developed an alternate estimate of room air conditioner sales over the next two years.

The 2010 U.S. Census estimated that there are approximately 116.7 million households in the U.S.²⁷ SMUD's residential population of 539,069 households makes up 0.46% of that value. ENERGY STAR® shipment data from 2010 through 2012 show shipment quantities of 2,101,000, 4,274,000, and 4,411,000 ENERGY STAR® room air

²⁶ <http://escholarship.org/uc/item/3kq4908x#page-10>

²⁷ <http://www.census.gov/prod/cen2010/briefs/c2010br-14.pdf>

conditioners, respectively. By referencing the market penetration data for ENERGY STAR® units, it is possible to estimate the total units shipped, both ENERGY STAR® and non-ENERGY STAR® qualified. For 2010-2012, this results in estimated total shipment of 6,366,000, 6,894,000, and 7,605,000 room air conditioners, respectively.

The Association of Home Appliance Manufacturers (AHAM) estimated an increase of 6.6% in total appliance demand in 2013, followed by another 7% demand increase in 2014. Multiplying these forecasts by the 2012 ENERGY STAR® shipment data results in an estimated 8,674,000 total room air conditioners shipped in 2014.

If 0.46% of these units are shipped and sold to SMUD residential households, that's roughly 40,000 room air conditioners in 2014 or, applying the 2014 demand increase to 2015, roughly 83,000 room air conditioners in 2014-2015.

Although the participant and non-participant survey results provided information regarding room air conditioner saturation rates, the findings did not provide sufficient insight into customers' future plans to purchase room air conditioners. As the saturation rate for room air conditioners is fairly low, a larger sample size of customers would be necessary to gauge what portion of the customer base is planning to replace their current room air conditioner or purchase a new model. The current assessment of market potential for room air conditioners relies on the two methods presented above. Preference should be given to the ENERGY STAR® unit shipment data rather than the replacement calculation, as a substantial portion of customers purchasing units will be those who do not currently own room air conditioners. The estimate of 83,000 room air conditioner shipments to the SMUD area addresses both replacement customers and new purchase customers and is likely a more comprehensive estimate.

ENERGY STAR® market penetration values for room air conditioners indicate that in 2012, ENERGY STAR® room air conditioners had a market penetration level of 58%. Applying this market penetration value to the two-year forecast of 83,000 room air conditioner shipments suggests that approximately 48,000 ENERGY STAR® room air conditioners will be sold to SMUD customers within the next two years.

6.2.4 Dishwashers

ADM used the results of the program participant and non-participant SMUD customer survey to estimate the saturation rate for dishwashers. This involved combining the reported dishwasher saturation rates for the following two groups:

- Program participants who had not received a dishwasher rebate through the program; and
- Program non-participant homeowners.

Out of the 222 participants surveyed, 77 had received a dishwasher rebate through the Residential Appliance Efficiency Program. Eighty-four percent of the remaining respondents reported that they owned a dishwasher. In the non-participant survey, 89% of respondent homeowners reported that they owned a dishwasher. Combining these

results, the estimated average number of dishwashers per household rounds to .85. Multiplying the estimated number of dishwashers per household by the number of SMUD residential accounts produces an estimate of dishwashers currently in residential use in the Sacramento region. This number is 457,581 dishwashers.

The Database for Energy Efficient Resources (DEER) estimates the expected useful life of a dishwasher to be approximately 11 years.²⁸ If one in every 11 dishwashers in SMUD residential households is replaced over the next year, that would be approximately 42,000 dishwashers, or 84,000 dishwashers over the next two years. To check the reasonableness of this estimate, ADM developed two alternate estimates of dishwasher sales over the next two years.

The 2010 U.S. Census estimated that there are approximately 116.7 million households in the U.S.²⁹ SMUD's residential population of 539,069 households makes up 0.46% of that value. ENERGY STAR® shipment data from 2010 through 2012 show shipment quantities of 5,644,000, 5,309,000, and 5,072,000 ENERGY STAR® dishwashers, respectively.³⁰ By referencing the market penetration data for ENERGY STAR® units, it is possible to estimate the total units shipped, both ENERGY STAR® and non-ENERGY STAR® qualified. For 2010-2012, this results in estimated total shipment of 5,644,000, 5,530,000, and 5,698,000 dishwashers, respectively.

The Association of Home Appliance Manufacturers (AHAM) estimated an increase of 6.6% in total appliance demand in 2013, followed by another 7% demand increase in 2014.³¹ Multiplying these forecasts by the 2012 ENERGY STAR® shipment data results in an approximate estimate of 6,500,000 total dishwashers shipped in 2014.

If 0.46% of these units are shipped and sold to SMUD residential households, that's roughly 30,000 dishwashers in 2014 or, applying the 2014 demand increase to 2015, roughly 62,000 dishwashers in 2014-2015.

ADM also asked survey respondents if they are planning to purchase a dishwasher within the next two years. Figure 21 shows respondents' replies. This figure includes responses from program participants who did not receive a dishwasher rebate through the program, and from non-participant homeowners.

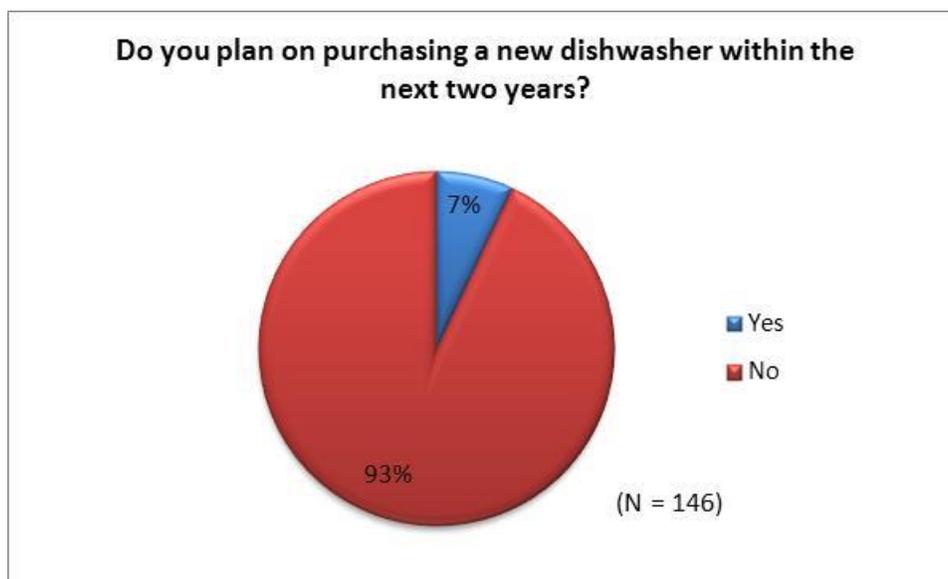
²⁸ Obtained from the Database for Energy Efficient Resources (DEER): <http://www.deeresources.com/>

²⁹ <http://www.census.gov/prod/cen2010/briefs/c2010br-14.pdf>

³⁰ Obtained from 2010, 2011, and 2012 Unit Shipment Data reports: www.energystar.gov

³¹ Association of Home Appliance Manufacturers (AHAM), AMUSA forecast, Sept 2013

Figure 21: Future Planning to Purchase Dishwashers



As Figure 21 shows, 7% of respondents indicated they are likely to purchase a new dishwasher within the next two years. The 2010 Census estimated that Sacramento County has a population of 1,055,578 people above the age of 18.³² If 7% of these people were to purchase a dishwasher over the next two years, that would be approximately 74,000 dishwashers sold.

Averaging the three forecasted values (84,000, 62,000, and 74,000) results in an estimate of 73,000 residential dishwashers sold to SMUD customers in 2014-2015. ENERGY STAR® market penetration data for dishwashers indicates that in 2012, ENERGY STAR® residential dishwashers had a market penetration level of 89%. Applying this market penetration value to the two-year forecast suggests that roughly 65,000 ENERGY STAR® dishwashers will be sold to SMUD customers within the next two years.

6.3 Retail Salesperson Interview Findings

ADM visited a total of five participating retail locations. At these stores, ADM was able to conduct short interviews with salespeople in the appliance department. The goal of these interviews was to gain further insight into the purchasing decisions of consumers in the market for clothes washers, refrigerators, room air conditioners, and dishwashers. Respondents were first asked to name appliance characteristics that customers care about most when deciding between different models for purchase. Answers were

³² Note: the population of Sacramento County is used as a proxy for the number of people living in residential homes serviced by SMUD.

recorded for as many characteristics as the salespeople mentioned. Table 78 shows the characteristics mentioned and the number of salespeople who mentioned them.

Features were the most commonly mentioned characteristic, followed by price and energy efficiency. None of the interviewed salespeople mentioned that the warranty was an important characteristic to customers, and only one interviewee mentioned the looks or style of the product as being important.

Table 78: Reported Customer Preferences in Appliance Choice

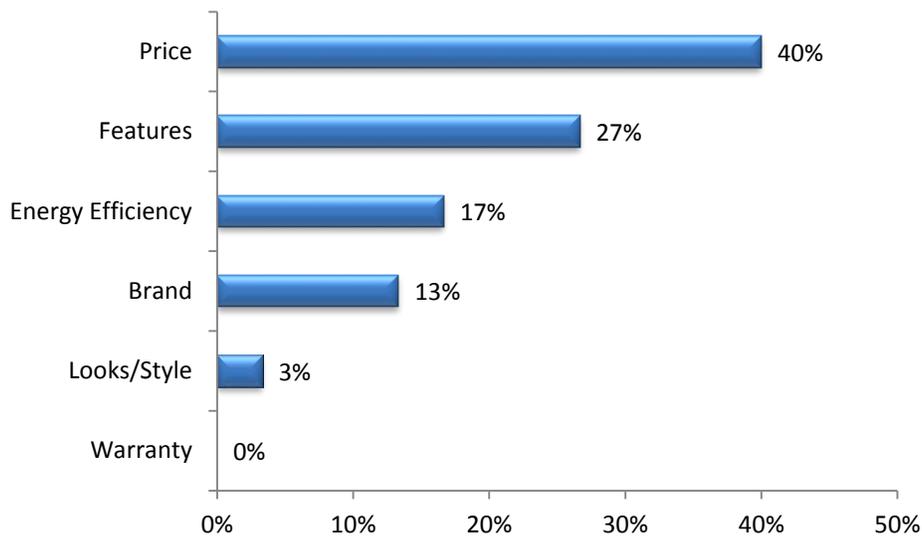
| <i>Characteristic</i> | <i>Number of Mentions (n=5)</i> |
|-----------------------|---------------------------------|
| Price | 4 |
| Brand | 3 |
| Features | 5 |
| Looks/Style | 1 |
| Warranty | 0 |
| Energy Efficiency | 4 |

The salespeople were next asked to rank the top three characteristics they mentioned in order of importance to customers. Table 79 summarizes the rankings, while Figure 22 shows the rankings as weighted percentages of the total responses (ranked first responses are multiplied by 3, ranked second responses multiplied by 2, and ranked third response are multiplied by 1). Price was ranked first by four of the five salespersons interviewed, confirming that it is the top consideration for most customers. Price was followed by features, with one salesperson ranking features first and two salespeople ranking features second. It seems that some customers may care about energy efficiency, but the vast majority of consumers are primarily interested in price and features.

Table 79: Top Three Customer Preferences in Appliance Choice

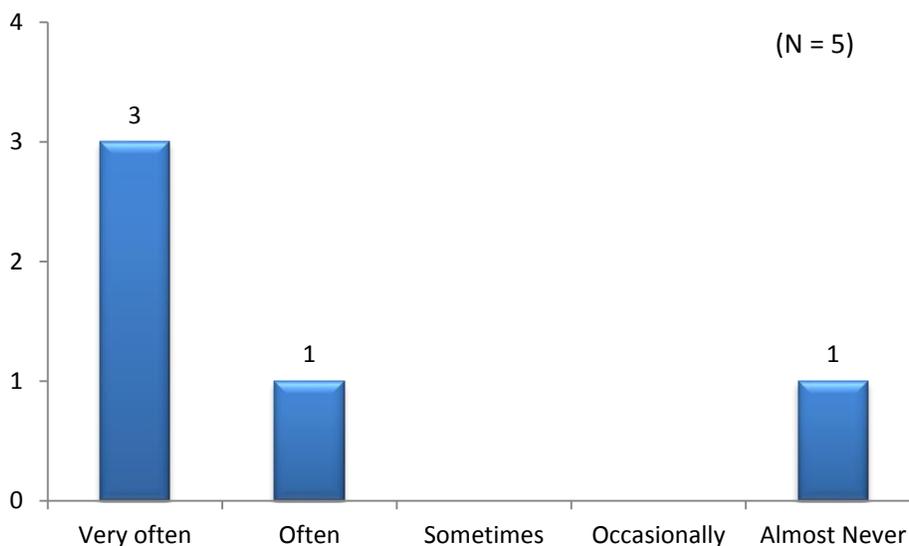
| <i>Characteristic</i> | <i>Number of Times Ranked First</i> | <i>Number of Times Ranked Second</i> | <i>Number of Times Ranked Third</i> |
|-----------------------|-------------------------------------|--------------------------------------|-------------------------------------|
| Price | 4 | - | - |
| Brand | - | 1 | 2 |
| Features | 1 | 2 | 1 |
| Looks/Style | - | - | 1 |
| Warranty | - | - | - |
| Energy | - | 2 | 1 |

Figure 22: Weighted Importance of Characteristics Mentioned.



When asked how often customers ask about energy efficiency, the majority of interviewed salespeople stated that customers 'very often' ask about energy efficiency.

Figure 23: Customer Inquiries about Energy Efficiency



To gauge salesperson awareness of the Residential Appliance Efficiency Program and energy efficiency in general, respondents were asked if they were aware of the SMUD rebates. All of the salespeople reported that they were aware of the SMUD rebates and that they point them out to customers who are considering the purchase of eligible appliances.

When asked how they typically identified energy efficient models when working with customers, four out of the five salespeople stated that they point out the ENERGY STAR® label. One of these four mentioned that they also show the customer the SMUD marketing label on the appliance. The remaining salesperson stated that they refer customers to the Energy Guide label in order to show them estimated appliance energy usage and efficiency levels.

In order to gauge customer awareness of the SMUD appliance rebates, interviewed salespeople were asked what percentage of their customers are already aware of the rebates before being informed by store employees. Responses to this question ranged from 10% to 95% of customers already being aware of rebates; the average percentage was about half (48%). These results support the findings of the participant and non-participant surveys, which suggested that a substantial portion of customers are becoming aware of the SMUD rebates upon entering the store or making an appliance purchase.

6.4 Shelf-Level Inventory Findings

ADM field staff visited five participating retail locations throughout the Sacramento area and conducted detailed inventories of all the clothes washers, refrigerators, room air conditioners, and dishwashers on the stores' shelves. These store visits were conducted in early 2014. ADM staff recorded make and model numbers, measure type, and documented the presence of ENERGY STAR® labels. This section summarizes key findings from these retail store visits, including appliance counts and other inventory characteristics.

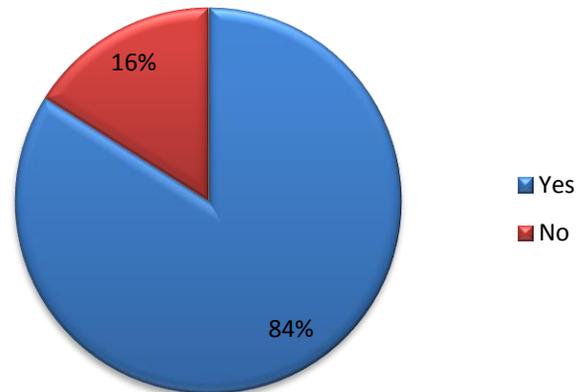
6.4.1 Clothes Washers

There were a total of 126 clothes washers on display at the five retail stores ADM field staff visited. This averages to approximately 25 clothes washers per store. The number of clothes washers on display varied from 20 to 33 models in each store.

Eighty-four percent of the displayed clothes washers were ENERGY STAR® certified. The average Energy Guide listed annual kWh usage for ENERGY STAR® clothes washers was approximately 158 kWh, while the average listed annual usage for standard efficiency units was about 444 kWh.

Figure 24: Presence of ENERGY STAR® Label, Clothes Washers

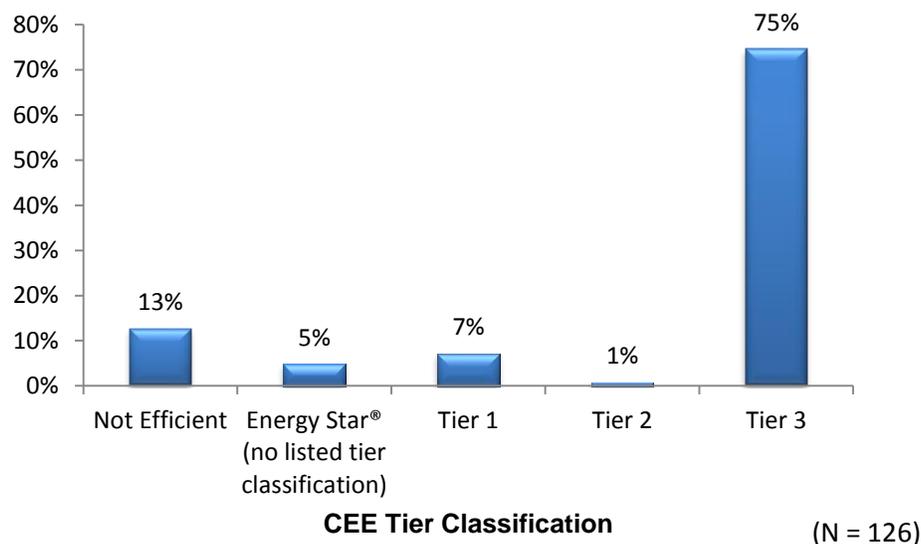
Energy Star® Label Present



(N = 126 clothes washers)

ADM also determined the CEE Tier for the clothes washers identified in retail stores. As shown in the figure below, the majority of units were classified in CEE Tier 3.

Figure 25: CEE Tier Classification Distribution, Clothes Washers



(N = 126)

The price of clothes washers in stores ranged from approximately \$350 to \$1,550, with the average unit price being about \$860. The lowest cost ENERGY STAR® clothes washer was \$448, while the highest cost standard efficiency clothes washer was \$1,099.

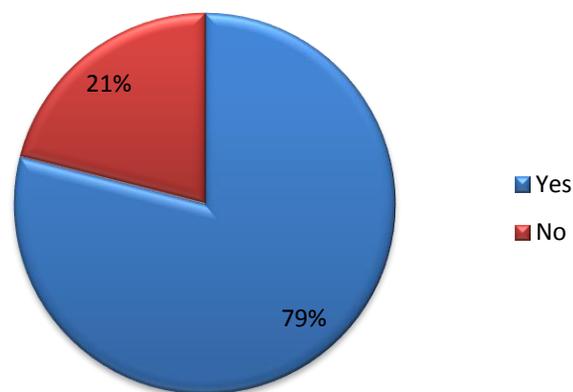
6.4.2 Refrigerators

There were a total of 289 refrigerators on display at the five retail stores ADM field staff visited. This averages to approximately 58 refrigerators per store. The number of refrigerators on display varied widely, from as few as 30 to as many as 82 models per store.

Approximately 80% of the displayed refrigerators were ENERGY STAR® certified. The average Energy Guide listed annual kWh usage for ENERGY STAR® refrigerators was 503 kWh, while the average listed annual usage for standard efficiency units was about 528 kWh. The lowest estimated annual kWh usage for any ENERGY STAR® refrigerator was 346 kWh, while the highest was 621 kWh.

Figure 26: Presence of ENERGY STAR® Label, Refrigerators

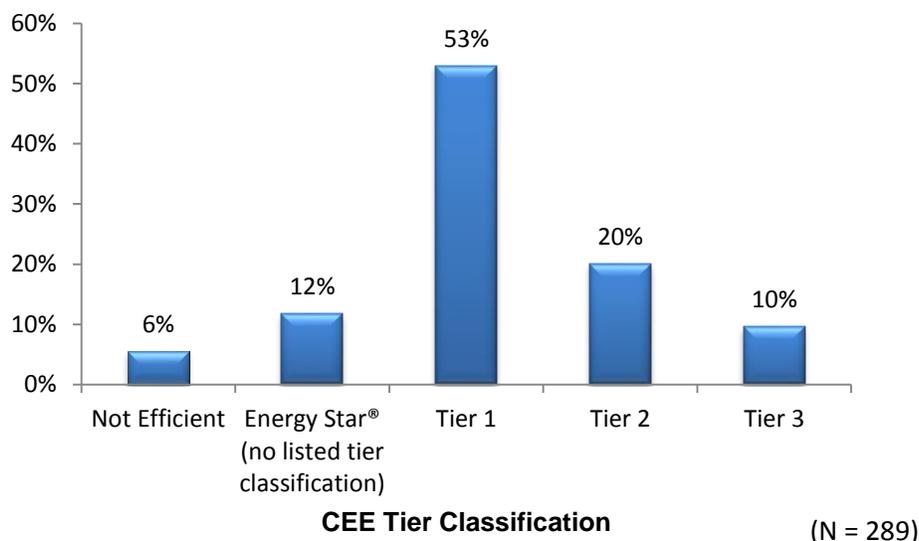
Energy Star® Label Present



(N = 289 refrigerators)

ADM also determined the CEE Tier for the refrigerators identified in retail stores. As shown in the figure below, the majority of units were classified in CEE Tier 1. Thirty percent of units were either in Tier 2 or Tier 3.

Figure 27: CEE Tier Classification Distribution, Refrigerators



The price of refrigerators in stores ranged from approximately \$380 to \$9,599, with the average unit price being about \$1,862. The lowest cost ENERGY STAR® refrigerator was \$499, while the highest cost refrigerator without an ENERGY STAR® label was \$9,599. The lowest cost standard efficiency refrigerator was \$378.

6.4.3 Room Air Conditioners

Only one of the visited retail stores had room air conditioners on display. This location had five models in total.

Three of the five displayed room air conditioners were listed as ENERGY STAR® units. Energy Guide annual kWh information was not available for the displayed air conditioners, although typically ENERGY STAR® room air conditioners use about 15% less energy than standard efficiency models.³³

Due to the large variation in cooling capacity, it is difficult to accurately compare unit prices of room air conditioners from a small sample of models. In terms of the units on display, the ENERGY STAR® models ranged in price from \$330 for a 12,000 BTU model to \$500 for an 18,500 BTU model. One of the conventional air conditioners with a 5,000 BTU capacity was listed at \$133.

³³ Information obtained from the ENERGY STAR® website: http://www.energystar.gov/certified-products/detail/air_conditioning_room

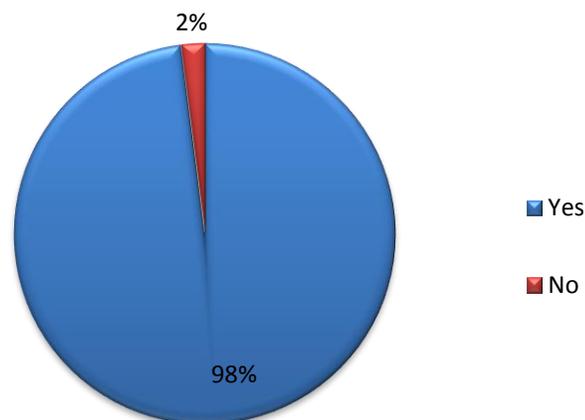
6.4.4 Dishwashers

There were a total of 123 dishwashers on display at the five retail stores ADM field staff visited. This averages to approximately 25 dishwashers per store. The number of dishwashers on display varied from as few as 12 to as many as 35 models per store.

More than 98% of the displayed dishwashers were ENERGY STAR® certified. The average Energy Guide listed annual kWh usage for ENERGY STAR® dishwashers was 270 kWh, while the average listed annual usage for standard efficiency units was about 305 kWh. The lowest estimated annual kWh usage for any ENERGY STAR® dishwasher was 135 kWh, while the highest was 324 kWh.

Figure 28: Presence of ENERGY STAR® Label, Dishwashers

Energy Star® Label Present



(N = 123 dishwashers)

The price of dishwashers in stores ranged from approximately \$260 to \$2000, with the average unit price being about \$746 (the median was \$699). The lowest cost ENERGY STAR® dishwasher was \$259, while the highest cost dishwasher without an ENERGY STAR® label was \$1,999. The lowest cost standard efficiency refrigerator was \$299.

7. Program Recommendations

This section summarizes key recommendations for the Residential Appliance Efficiency Program. These recommendations are based on the range of evaluation activities conducted for the 2010-2012 program years, including customer surveys, savings verification procedures, program documentation and tracking review, and other tasks.

Recommendations

The following recommendations are based on the range of evaluation activities conducted for the 2010-2012 program years, including customer surveys, savings verification procedures, program documentation and tracking review, and other tasks.

Documentation of Savings Methods: ADM found that it was sometimes unclear which sources or assumptions were used in determining ex ante program savings. This can cause issues during the evaluation process and can lead to inconsistent savings estimates among measures or between program years. It is recommended that SMUD maintain updated documentation regarding the sources, assumptions, and algorithms used for each calculation, and to ideally provide copies or links to these data sources for future evaluation efforts.

Market Penetration Monitoring: Household appliances are a fast moving market, and energy efficiency levels are increasing with ENERGY STAR® market penetration expected to grow. The shelf level inventory review showed that many currently-available and popular appliance models are energy efficient, and the retail store interviews suggested that a substantial portion of customers are beginning to seek energy efficient appliances prior to being aware of available rebates. An annual review of available market data, ENERGY STAR® and CEE standards, and emerging appliance trends is recommended to ensure that SMUD is promoting the most energy efficient options. Thus far, it appears that SMUD has revised program eligibility and other characteristics in order to stay current with market trends. Continuing this proactive approach to program design will contribute to higher net-to-gross ratios and incremental efficiency gains.

Baseline Identification: Federal and state appliances are subject to change and these changes affect the baseline efficiency assumptions used for gross savings calculations. It is important that there is an awareness regarding these changes and how they affect the program. Upcoming changes for program measures are described in the Gross Impact Evaluation section of this report for all appliance types.

8. Appendix A: Data Collection Instruments

The following embedded documents contain the data collection instruments used for this evaluation. Specifically, the participant survey, non-participant survey, shelf inventory data collection form /retail sales-person interview guide, and participant home visit data collection form are provided.



Participant Survey



Non-Participant
Survey



Shelf Inventory &
Interview



Home Visit Data
Collection Form