GDS Associates, Inc.

2014 Pennsylvania Statewide Act 129 Residential Baseline Study

Presented to the Pennsylvania Public Utility Commission


Submitted by: **GDS Associates, Inc.**
In partnership with: **Nexant, Inc., Research Into Action & Apex Analytics**

April 2014

Acknowledgements

We would like to extend a special thanks to the staff of the seven electric distribution companies highlighted in this report. Their cooperation and assistance in providing the necessary information to compile this report was vital to this study's success and is greatly appreciated. Specifically, we would like to thank Dave Defide of Duquesne Light, Chris Siebens and Lisa Wolfe of FirstEnergy, Pete Cleff and Mike Stanz of PPL, and Nick DeDominicis of PECO. Finally, we thank the Bureau of Technical Utility Services (TUS) staff of the Pennsylvania Public Utility Commission for their guidance and assistance in writing this report.

CONTENTS

LIST OF FIGURES

LIST OF EQUATIONS

LIST OF TABLES

1 EXECUTIVE SUMMARY

1.1 OVERVIEW

This report presents the results of a residential energy efficiency baseline study for the service areas of seven investor-owned electric utilities in Pennsylvania. GDS Associates, Inc. (GDS), Nexant, Inc. (Nexant), Research Into Action (RIA), and Apex Analytics – collectively known as the Statewide Evaluation (SWE) Team – were contracted by the Pennsylvania Public Utility Commission (PUC) to perform an energy efficiency potential assessment for the State of Pennsylvania and its seven largest electric distribution companies (EDCs) for Phase III of Act 129 (starting June 2016). The EDCs included as part of this study are below:

- Duquesne Light Company (DLC)
- Metropolitan Edison Company (MetEd)
- Pennsylvania Electric Company (Penelec)
- Pennsylvania Power Company (Penn Power)
- West Penn Power Company (WPP)
- PPL Electric Utilities (PPL)
- PECO Energy Company

The first step in the energy efficiency potential assessment process is to establish baseline energy use and building characteristics for the residential, commercial and industrial sectors. This report documents the findings of the end use and saturation study of the residential sector[1], and serves to provide baseline energy equipment saturations as well as electric equipment energy efficiency levels for the subsequent residential electric energy efficiency potential assessment.

This study evaluates the characteristics of the energy using equipment, the efficient electric equipment stock and building characteristics present in the residential sector of Pennsylvania for the seven EDC service territories. GDS used its experience working with the Pennsylvania EDCs over the last four years (as part of the SWE Team evaluating their current energy efficiency programs) and performing previous energy efficiency baseline and potential studies to help identify the critical data collection needs from the on-site surveys that will be integral to future resource planning and energy efficiency activities in Pennsylvania.

The results of this study rely upon primary research conducted in the form of onsite customer surveys. A review of available secondary sources, such as US Census data and manufacturer product data, was also performed in an effort to clarify and compliment primary research efforts in addition to filling in gaps – either in the presence or quality of data.

1.2 METHODOLOGY

The SWE Team performed on-site surveys during Fall 2013 to collect detailed and accurate inventories of residential appliance, equipment, and housing characteristics for residential consumers throughout

[1] A companion report, issued by Nexant, will detail the findings in the non-residential sectors.

the state of Pennsylvania. This study captured a variety of energy-related data, including the penetration of electric and non-electric equipment and appliances, energy efficiency levels of electric equipment and appliances, building shell characteristics, lighting socket counts, and other relevant information.

A total of 490 site surveys stratified by EDC, housing segment, and annual kWh consumption were conducted. The desired level of precision for EDC-specific results, ±10% precision, with 90% confidence, necessitated a total of 70 on-site visits per EDC. The data for all EDC's were then aggregated to the statewide level, and these estimates carry precision of ±5% precision, with 95% confidence. The sample size was not large enough, nor was it intended, to provide housing segment specific results (e.g. a data breakdown by single-family, multi-family, and manufactured homes) within each EDC.[2]

The survey estimates presented in this report are subject to a certain degree of uncertainty. Practical constraints make it impossible for the SWE team to conduct an on-site survey of the entire population of Pennsylvania residences, necessitating the selection of a sample population from which to collect data. When using a sample to estimate a population metric, factors of uncertainty are introduced, primarily based on the size of the sample and the existence of biases within the sample.

The uncertainty can be described by the confidence level and margin of error. As noted above, the targeted confidence level and margin of error in this study was set at 95% and 5%, respectively, for the state-wide residential sector. This means that if this study were repeated multiple times, 95% of the studies would produce estimates to within ±5% of the true population value.

Given the different characteristics between single family (SF), multifamily, and manufactured homes, the SWE team developed case weights to control for sample bias when presenting results by EDC. Further, in an effort to provide a more inclusive study and to provide estimates for each of the EDC territories, a sample of 70 residential sites was selected for each EDC irrespective of the size of the EDC. Thus, when aggregating the EDCs estimates to the statewide level, it was necessary to create a second set of case weights to control for differences in the number of residential accounts across the seven EDCs. This approach assigns greater weight to the data for larger EDCs when compared to smaller EDCs in the statewide findings.

1.3 STATEWIDE RESULTS

Statewide level findings include data collected from all 490 on-site surveys. The data presented below represents statewide results for all housing types combined. More detailed data, including a breakdown by housing type is included in section 4 (Statewide Residential Findings) of this report.

This report frequently sites two metrics: penetration and saturation. It is important to understand how each is defined in this study. Penetration is the proportion of households that have one or more of a particular appliance (or other piece of equipment). It is calculated by dividing the number of customers

[2] At the statewide level, there were a significant number of observations to make statistically valid conclusions with better than ±10% precision, with 90% confidence for SF-Detached housing, SF-Attached and multifamily housing segments. Results for manufactured housing may only be sufficient to make assumptions at ±15% precision.

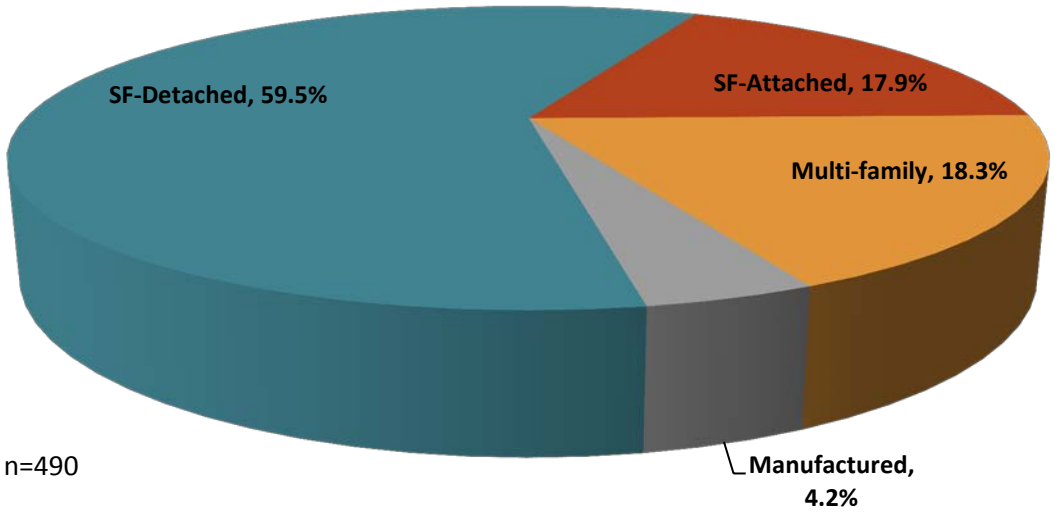
with one or more of an appliance (or other pieces of equipment) by the total number of surveys with responses to that question.

Alternatively, saturation represents how many of a particular appliance/equipment exists among all customers. It is calculated by dividing the total number of a particular appliance/equipment by the total number of surveys with responses to that question. This percentage is typically higher than the corresponding penetration, because some households will have more than one of a given appliance (except lighting).[3] In select cases (such as refrigerators, televisions and computers), saturation will exceed 100% due to high penetrations and the common occurrence of households with multiple units.

1.3.1 Basic Home Characteristics

Housing Type. After applying the statewide weighting factors, SF-Detached housing represents 60% of the total surveyed housing units. Multifamily housing (condos, apartments, etc.) and SF-Attached (townhouses, row houses, duplexes) both represent 18% of the statewide housing units, followed by manufactured (or mobile) homes (4%).[4]

Figure 1-1: Statewide Residences by Housing Type



Average Age. The average age of housing units statewide was 55 years old. Approximately 47% of homes were built prior to 1960 while only 16% since 2000.

Average House Size. The average square footage of above ground conditioned space for all housing was 1,671 square feet.[5] Including conditioned basements, the average square footage for all housing was

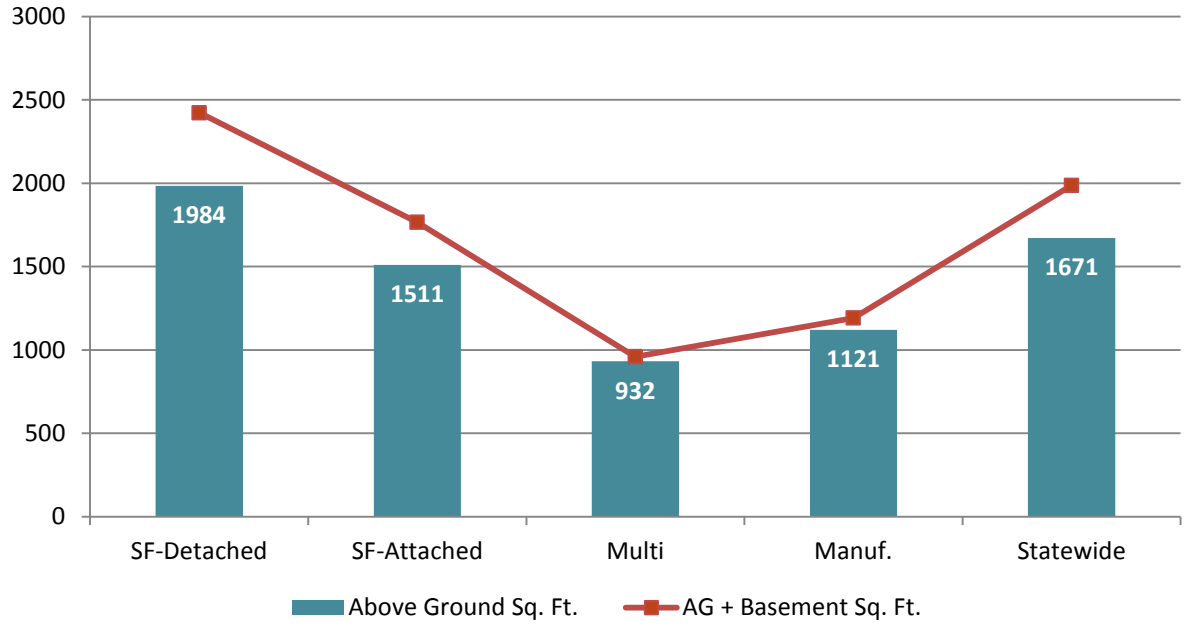
[3] Lighting saturation refers to the proportion of lighting represented by a given bulb type. For this reason, lighting saturation is lower than or equal to its corresponding penetration.

[4] Manufactured housing in this study refers to mobile homes and other housing on a fixed, steel chassis and towed to the home site. Modular homes are included as SF-detached housing.

[5] For purposes of this baseline study, conditioned space was generally classified as any area, room, or finished space being heated and/or cooled by equipment or appliance.

1,987 square feet. Single family detached housing square footage was 1,984 square feet (n=294), increasing to 2,423 after including conditioned basements. SF-Attached (n=77), multifamily (n=86), and manufactured housing (n=27) conditioned space square footage (including basements) ranged from roughly 960 sq. ft. to 1,766 sq. ft.

Figure 1-2: Average Square Feet of Conditioned Space by Housing Type[6]



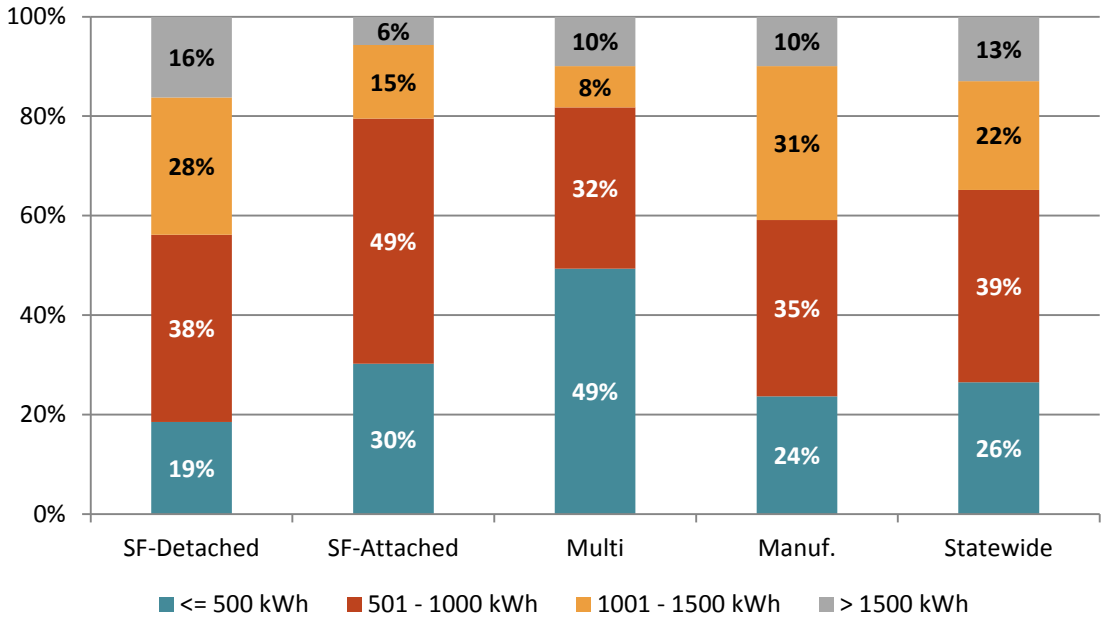
Monthly Energy (kWh) Use. Approximately 26% of surveyed homes statewide consumed less than 500 kWh per month based on 2012 historical billing data. 65% of homes consume less than 1,000 kWh per month. Only 13% consume more than 1,500 kWh monthly. In general, SF-Detached had the highest proportion of 1,500 kWh and above residences. As expected due to their smaller size, multifamily units were most likely to consume 500 kWh or less monthly.

Foundation. Approximately 66% of surveyed homes statewide had a basement (34% unconditioned 27% conditioned, and 6% mix of conditioned and unconditioned space). Only 8% and 6% of residences were slab on-grade or crawlspace foundations, respectively. 11% of homes were reported as having a mix of foundation types, and 9% homes surveyed were located above other conditioned units.

Other Demographics. Statewide, the average annual number of occupants was 2.4 persons per household. Nearly all homes were used as year-round residences (98%) and the majority of homes were owner-occupied (77%). Approximately 30% of all head of households were 65 years of age or older.

[6] "Statewide" refers to all housing types combined throughout this study.

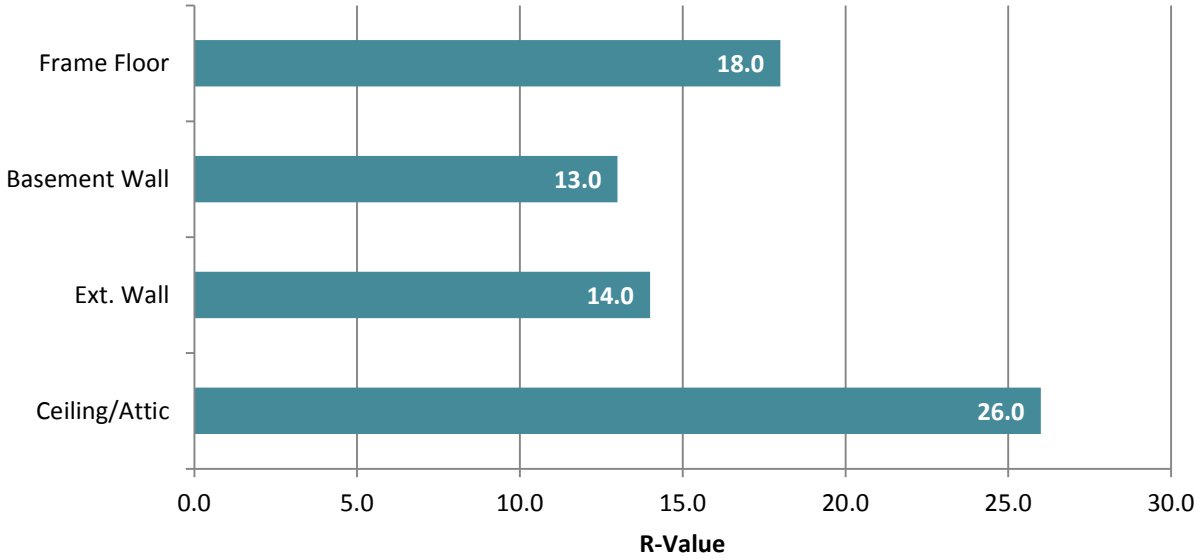
Figure 1-3: Distribution of Average Monthly kWh Consumption (based on 2012 historical billing data)



1.3.2 Building Shell

Insulation. Insulation was only verified to be absent in 9% of attics/ceilings and 19% of exterior side walls. Insulation was less common in basement walls or floor space (between conditioned and unconditioned space). When present, the average R-value of insulation (based on the insulation type and thickness), is depicted in the tables below for all houses statewide.

Figure 1-4: Average Insulation R-Value by Location



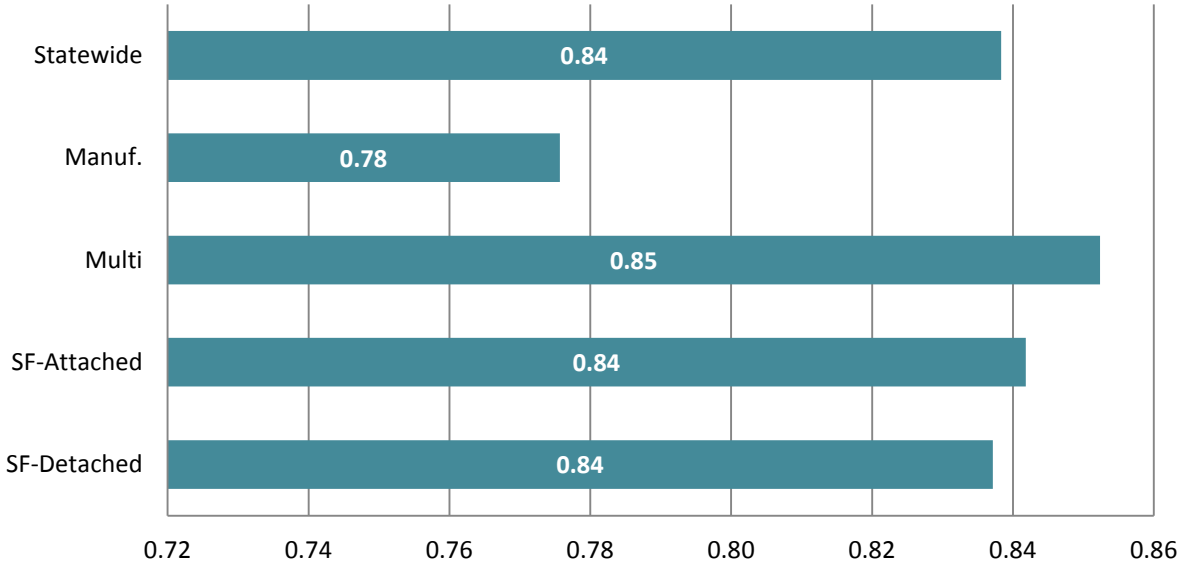
Windows. On average, houses statewide have a total of 16 windows per residence. The average square footage of window area per home is 168 square feet. 9% of all surveyed windows statewide were single-paned windows. Approximately 26% of surveyed windows were double-pane low-E or triple-paned windows. The majority of windows were standard double-paned.

Table 1-1: Average Number of Windows, Window Area, and Glazing Type

Average # per Home	Average Window Area per Home	% of All Windows Single-Pane	% of All Windows Double Pane	% of All Windows DP Low-E or Triple Pane
16	168	9%	65%	26%

Duct Sealing. The surveyors combined three data fields related to ductwork (% within conditioned space, insulation on ductwork located outside the conditioned space, and the qualitative assessment of air sealing) to create an index of duct efficiency. This index was modeled after the Building Performance Institute's Distribution Efficiency Look-Up Table. The calculated distribution efficiency of the duct systems are provided below.

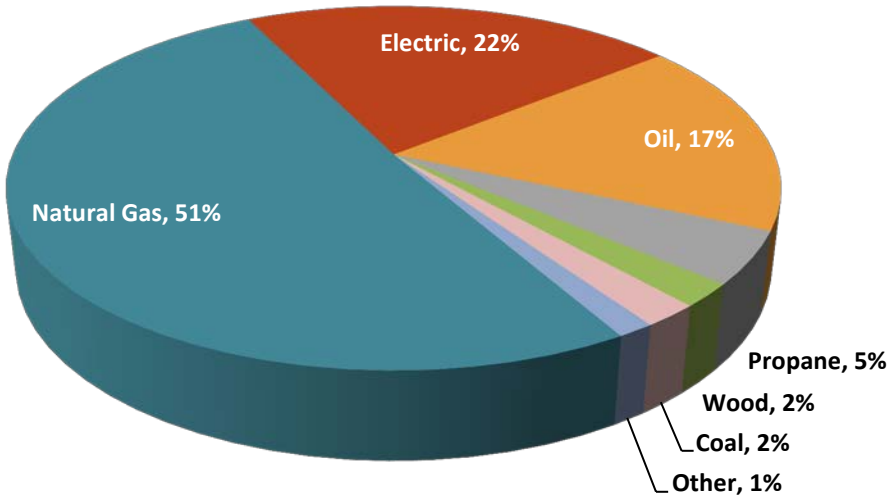
Figure 1-5: Distribution Efficiency of Duct System



1.3.3 HVAC Equipment

Heating Fuel Type. Natural gas was the most common primary heating fuel-type statewide (51%). Electric heating was the primary fuel in 22% of households statewide. Oil heating systems were the primary heating system in 17% of households. The other category includes kerosene, unknown and dual fuel heat systems.

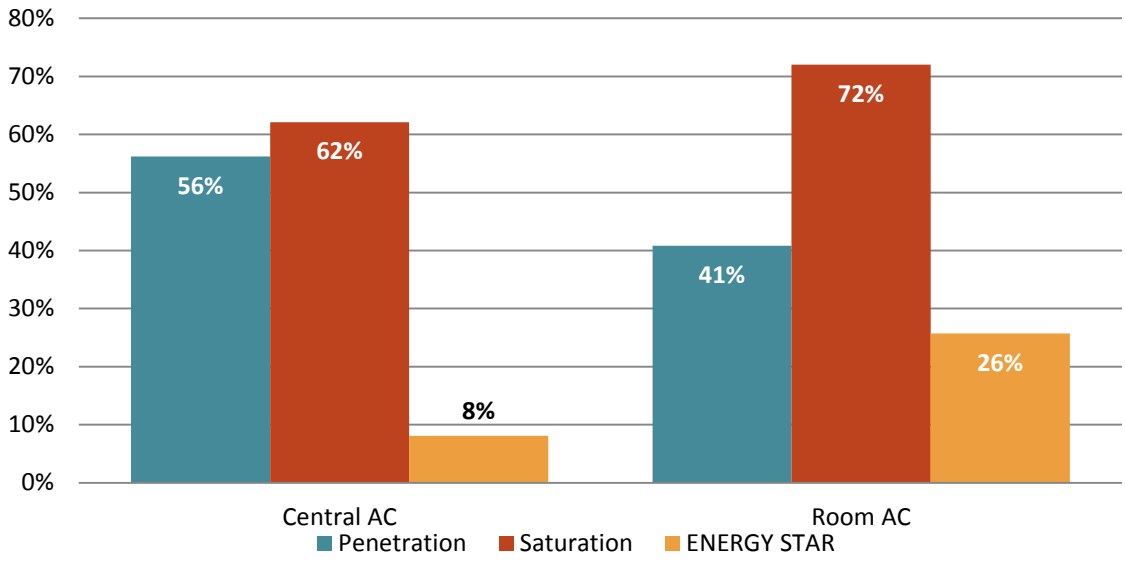
Figure 1-6: Primary Heat Fuel Type (All Fuels)



System Type (Primary Electric). The majority of all heating systems are central furnaces across all heating types; the most common primary electric heating systems are air source heat pumps (41%). Baseboard heating is also common among primary electric systems (26% of all electric heated homes statewide), and electric furnaces are found in 22% of primarily electric-heated homes. The remaining 11% of primary electric systems include wall-mounted space heating, and portable space heating units.

Cooling. 56% of homes have at least one central air conditioner and 41% of homes have at least one room air conditioner. After accounting for residences with multiple central or room air conditioning units, the saturation of central air conditioning in Pennsylvania households is 62% and the saturation of room air conditioners is 72%.

Figure 1-7: Penetration and Saturation of Cooling Systems



Only 8% of all central air conditioning, including central air only, heat pumps and mini-split systems, were verified to have a SEER rating of 14.5 or better (currently meeting or exceeding ENERGY STAR standards). For comparison, 38% of central air conditioners in residences statewide are currently below the minimum federal efficiency standard of SEER 13.

Room air conditioners were more efficient than central AC units: 26% of room air conditioners were either verified to possess an ENERGY STAR rating or exceeded current ENERGY STAR compliancy standards.

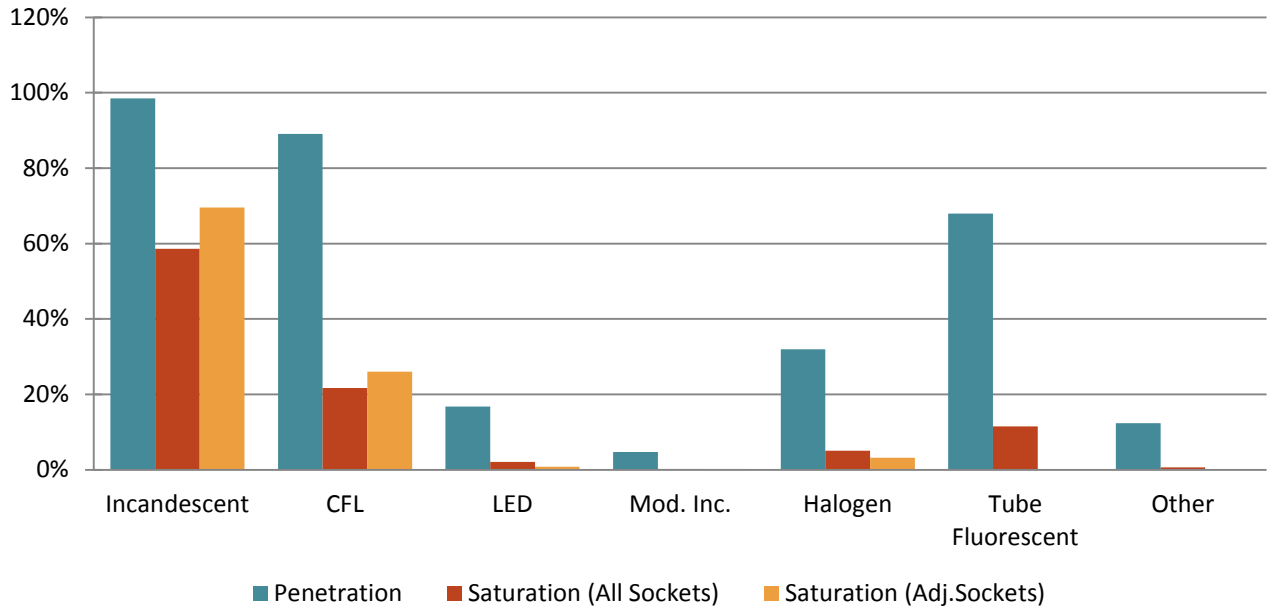
1.3.4 Lighting

Sockets per Home. On average, there were a total of 51 interior lighting sockets per home across all housing types statewide. SF-Detached housing had an even greater number of average sockets (66), followed by SF-Attached housing (38) and multifamily housing (20).

In addition to interior lighting, the average number of exterior lighting sockets was five. SF-Detached housing averaged 8 exterior bulbs per home, while other housing types typically had 2-3 exterior sockets per home.

Bulb Type. The penetration and saturation of interior lighting by bulb type is presented in the table below. Lighting saturation refers to the proportion of lighting represented by the given bulb type. For this reason, lighting saturation is lower than or equal to its corresponding penetration. Nearly 89% of all housing units statewide possess at least one compact fluorescent light (CFL) bulb. However, CFLs are only found in 22% of all sockets statewide. Incandescent lighting, by contrast, is found in 99% of all homes and 59% of all sockets.

Figure 1-8: Penetration and Saturation of Lighting by Bulb Type



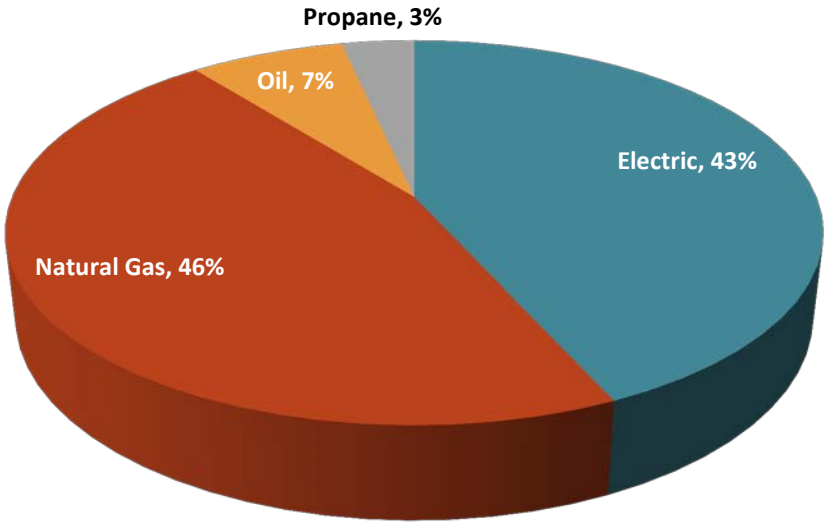
Not all sockets can easily be retrofitted with efficient lighting options. After eliminating current tube fluorescent lighting, night lights, other specialized lighting, and sockets that are currently empty, the average number of adjusted sockets per home that could reasonably be expected to receive CFL bulbs is reduced to 42 interior sockets. Based on this reduced socket count, current CFL saturation increases to 26% statewide.

Additional lighting detail related to interior lighting sockets, exterior lighting sockets and bulbs in storage can be found in Sections 4 (Statewide) and 5 (EDC Specific) of this report.

1.3.5 Water Heating

Fuel Type. The most common fuel type for domestic water heating is natural gas (46%), followed by electric (43%), and oil (7%). Other fuels for water heating, such as propane, are relatively uncommon.

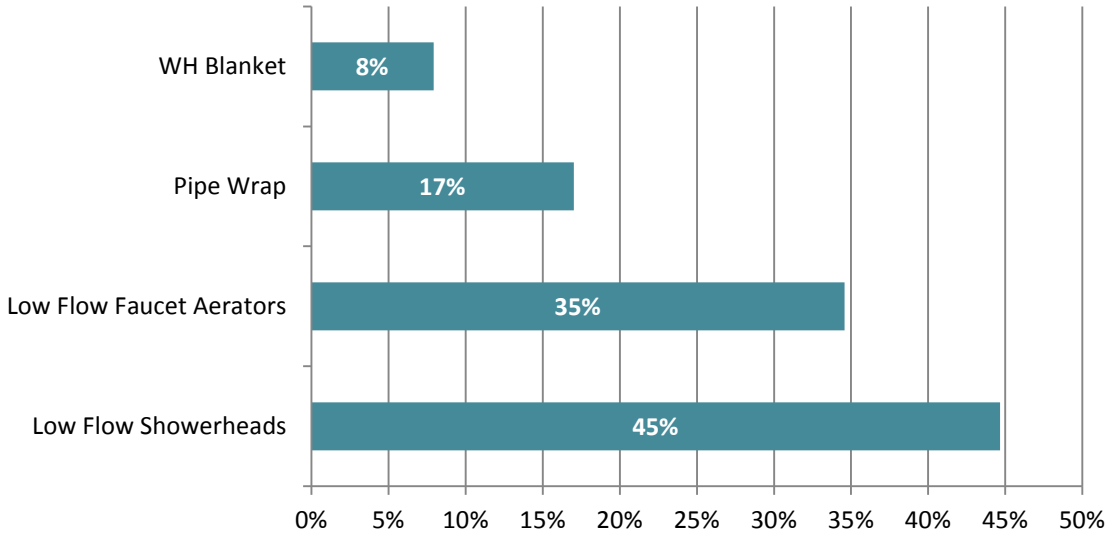
Figure 1-9: Water Heating Fuel Type



Efficient Water Heating Measures. The table below describes the percentage of equipment related to water heating that is currently energy efficient. 8% of electric water heaters are currently equipped with a water heater blanket (tank wrap) and 17% of pipes at or around the water heater are currently wrapped to reduce stand-by losses.

Low flow showerheads and faucet aerators were fairly common among surveyed housing units. Nearly 45% of all showers were equipped with the low-flow showerheads and 35% of all sinks were equipped with faucet aerators.

Figure 1-10: Water Heating Efficiency Measures



1.3.6 Appliances and Other

Appliance Penetration and Saturation. The table below outlines the penetration and saturation of all remaining major appliances, consumer electronics, and other common equipment for which we collected data. The saturation percentage is typically higher than the corresponding penetration because some households will have more than one of each appliance.

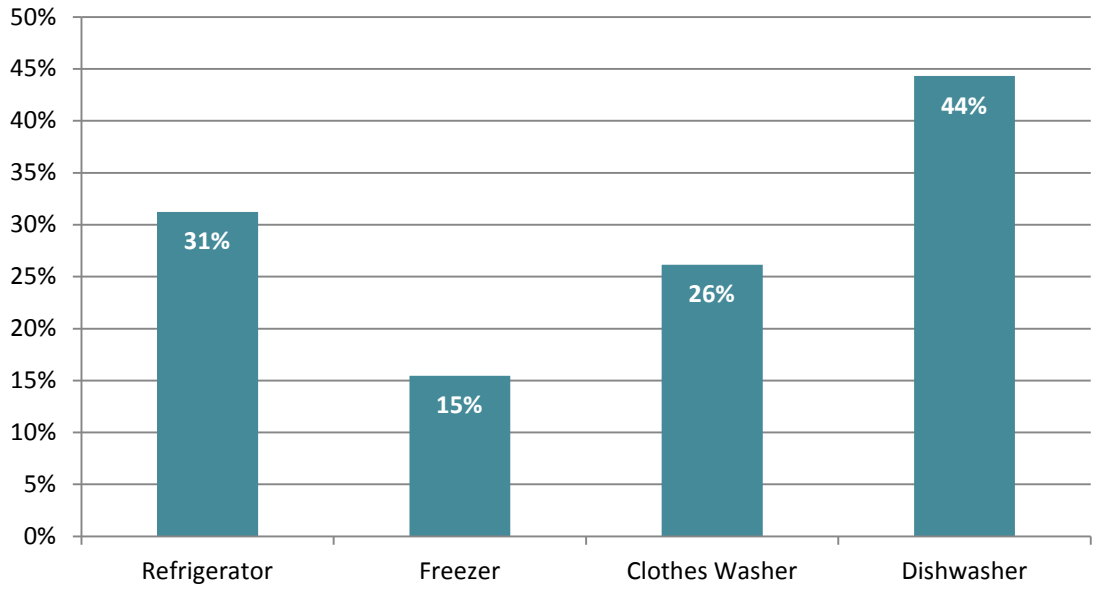
Table 1-2: Penetration and Saturation of Major Appliances and Other Equipment

Equipment	Penetration	Saturation
Major Appliances		
Refrigerators	100%	139%
Freezers	39%	42%
Dishwashers	67%	67%
Clothes Washers	90%	92%
Electronics		
Televisions	98%	278%
Desktop Computers	52%	63%
Laptops	63%	100%
Tablet PCs	33%	42%
DVD Players	85%	118%
VCR	44%	52%
Gaming Systems	41%	61%
Fax Machines	32%	37%

Equipment	Penetration	Saturation
Stereo Systems	52%	68%
Home Theatre	23%	25%
Mobile Phone Charger	93%	197%
Seasonal		
Dehumidifiers	36%	43%
Humidifiers	11%	13%
Ceiling Fans	76%	220%
Recreational		
Pools	6%	6%
Hot Tubs	5%	5%

Major Energy Star Appliances. Of the major appliances, dishwashers were the most common ENERGY STAR rated appliance. 44% of all dishwashers were verified to have been ENERGY STAR rated either by visual inspection or through manufacturer data. Similarly 31% of primary refrigerators, 26% of clothes washers and 15% of freezers were verified to have been ENERGY STAR rated.

Figure 1-11: ENERGY STAR Appliances



It should be noted that there are likely occasions where an appliance was ENERGY STAR compliant at one time, but may have since lost its rating due to increased efficiency standards. For purposes of this study, appliances that were once designated as ENERGY STAR (but would not meet current and updated standards) were included in the pool of efficient appliances.[7]

[7] This reporting is consistent with the SWE team's method for estimated energy efficient technology saturations used in the electric energy efficiency potential study.

1.3.7 Comparison of Results across Key Groups

Statistical significance testing was conducted on select variables to determine whether there are any differences regarding the installation of energy efficient lighting and appliances between various groups. The tests also compared the results of energy efficient equipment and installations in 2013 to the findings in 2011[8]. The analysis utilized the chi-square test and the t-test. All tests were executed at the 0.05 significance level. Results are presented at the statewide level in the table below

Table 1-3: Energy Efficient Equipment Findings - Comparison across Key Groups

Variable	Own	Rent	Less than 65	65 or older	Low - Income[9]	Non - Low - Income	2013	2011
Lighting								
Lighting (Saturation of CFL/LED Sockets - %)	***26%***	***33%***	***30%***	***21%***	***37%***	***26%***	***27%***	***21%***
Lighting (Avg. CFL/LED bulbs per home – All homes)	***14.2***	***6***	12.3	11.7	***6.5***	***13.4***	***12.1***	***9.4***
Lighting (Avg. CFL/LED bulbs per home – Homes with at least 1 CFL/LED)	***15.4***	***7.4***	13.7	13.4	***7.2***	***15***	13.6	11.5
Appliances								
Refrigerator (Energy Star - %)	***28%***	***10%***	22%	26%	25%	23%	24%	20%
Freezer (Energy Star - %)	20%	6%	17%	22%	12%	19%	***19%***	***7%***
Clothes Washer (Energy Star - %)	***26%***	***13%***	25%	22%	15%	25%	24%	24%
Dishwasher (Energy Star - %)	***47%***	***24%***	46%	43%	31%	46%	45%	38%
Room AC (Energy Star - %)	***30%***	***14%***	26%	26%	***14%***	***30%***	26%	21%
Shell								
Roof Insulation (Avg. R-value)	25	24	25	25	25	25	25	21
Wall Insulation (Avg. R-value)	13	12	13	13	13	13	13	15
Windows (Energy Efficient - %)	***29%***	***5%***	***29%***	***19%***	***2%***	***29%***	***26%***	***19%***

The shaded cells indicate that the differences are significant. There is a significant difference between owners and renters for all lighting variables, all but one appliance measure, and one of three shell characteristics. There are no statistically significant differences in the ownership of energy efficient appliances among those less than 65 years of age and those greater than 65 years of age. Only the saturation of efficient lighting and efficient windows are significantly different across age groups. Across income levels, there is a significant difference in room air conditioner ownership. There are also

[8] Data collection for the 2014 baseline report was performed in late 2013. Similarly, data for the 2012 baseline study was collected in late 2011.

[9] Low income status was assigned based on "known" low income households designated in the individual EDC customer databases, and may underestimate the actual percent of low income households in the sample. Due to sensitivity concerns, household income was not asked during the on-site assessments.

statistically significant differences in the saturation of efficient lighting and the average number of efficient bulbs across income levels. Low-income survey respondents had fewer efficient bulbs than non-low-income respondents, but efficient bulbs that low-income customers did own comprised a greater percentage of their total bulb count. A greater percentage of 2013 survey respondents own efficient appliances than did the 2011 respondents. Only efficient freezer ownership exhibited a statistically significant difference between the two datasets. The the number of efficient bulbs and saturation of efficient lighting is higher in 2013 compared to 2011.

1.4 EDC OVERVIEW

In addition to presenting results at the statewide level, this report also provides the results of the on-site surveys collected for each of the EDCs. EDC level results have been weighted based on housing type and age of head of household. See section 3.3.2 for more details.

More detailed and additional data tables are included in section 5 (EDC-Specific Findings) of this report.

1.4.1 Electric Fuel Share by End Use

The percentage of homes that are primarily heated, with electricity, not including dual fuel systems, ranged from 9% in the Duquesne service area to 30% in the Penn Power and PPL territories. Electric space cooling, either in the form of central cooling systems or room air conditioners, ranged from 80% in the Penelec area to 99% in the PECO territory. Electric water heating ranged from 17% of surveyed homes (Duquesne) to 56% (PPL). Other major electric end-uses (lighting, appliances, and electronics) were found in 100% of surveyed homes.

Table 1-4: Electric Fuel Share by End Use

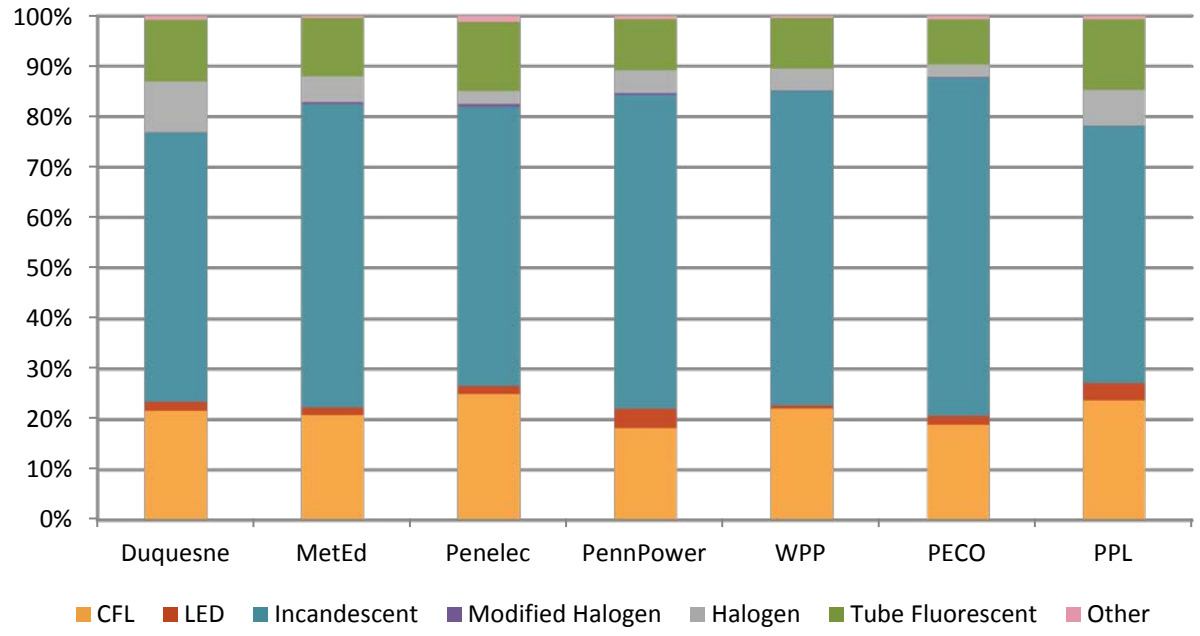
Electric End Use Share	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Primary Space Heating	9%	20%	12%	30%	22%	22%	30%
Space Cooling	91%	94%	80%	87%	91%	99%	89%
Water Heating	17%	50%	40%	55%	44%	38%	56%
Lighting	100%	100%	100%	100%	100%	100%	100%
Appliances/Plug Load	100%	100%	100%	100%	100%	100%	100%

1.4.2 Lighting

Figure 1-12 demonstrates the saturation of all interior sockets by bulb type. In general, 18%-25% of all interior sockets were fitted with compact fluorescent light (CFL) bulb technology. By contrast, the saturation of incandescent lighting ranged from 51% to 67% of all interior sockets. The saturation of LED bulb technology is less than 5% across the EDCs.

After accounting for interior lighting sockets where CFL bulbs are unlikely to be replaced due to incompatible socket and bulb types (i.e. current fluorescent tube fixtures, pin-based bulbs, nightlights, and other specialized lighting), the saturation of CFL lighting increases to 22%-30% of all eligible bulb types.

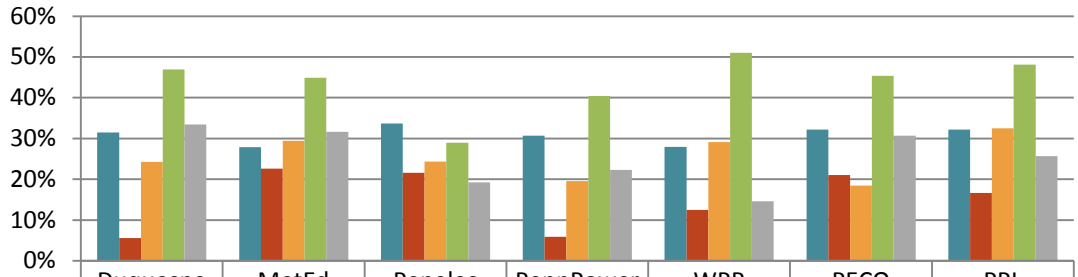
Figure 1-12: Interior Lighting Socket Saturation by Bulb Type



1.4.3 ENERGY STAR Appliances by EDC

In general, dishwashers and refrigerators were the two appliances most likely to possess an ENERGY STAR rating in households across the seven EDCs, followed by clothes washers and room air conditioners. Stand-alone freezers were generally found to not have the ENERGY STAR rating. Detail regarding the efficiency levels of other electric equipment, including HVAC and water heating systems by EDC can be found in section 5 of this report.

Figure 1-13: ENERGY STAR Appliances by EDC



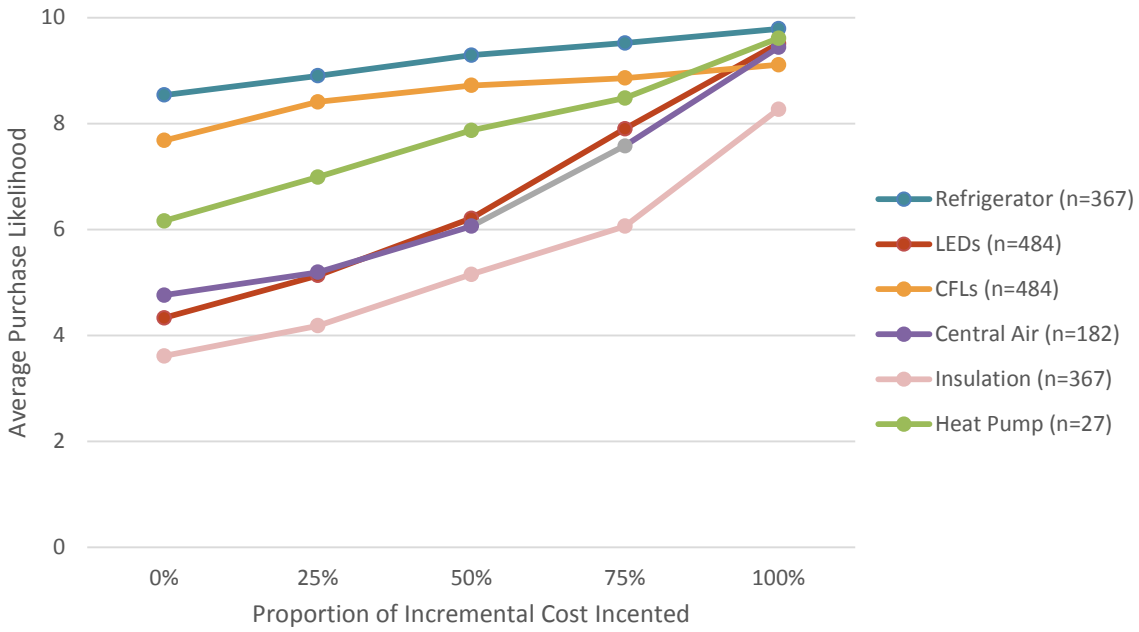
	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
Refrigerator	31%	28%	34%	31%	28%	32%	32%
Freezer	6%	23%	22%	6%	13%	21%	17%
Clothes Washer	24%	29%	24%	20%	29%	18%	32%
Dishwasher	47%	45%	29%	40%	51%	45%	48%
Room AC	33%	32%	19%	22%	15%	31%	26%

1.5 WILLINGNESS TO PAY FINDINGS

The objective of the residential baseline study's willingness-to-pay (WTP) exercise was to gauge residential customers' relative purchase likelihood (or willingness-to-pay) for six residential energy efficiency measures under a series of pricing scenarios designed to mimic the incentives of a hypothetical consumer-focused energy efficiency program (see Chapter 6 for a complete discussion of methods and findings). Respondents used a 0-to-10 scale to rate their likelihood of purchasing energy efficient at varying incentive levels (from 0% to 100% of the incremental measure cost).

Respondents' average reported purchase likelihood for each of the measures in the WTP exercises increased at each offered incentive level (0%, 25%, 50%, 75% and100% of the increment measure cost).

Figure 1-14: Average Purchase Likelihood Ratings by Incentive Level



Consistent with their lower incremental cost and relatively mature technology status, respondents reported the highest likelihood to purchase efficient refrigerators and CFLs without incentives, but incentives that covered a portion of the incremental cost for these two measures had a correspondingly lower influence on respondents' willingness to pay than for other measures. Furthermore, the relative effect of an increased incentive on purchase likelihood diminishes above 50% of incremental cost.

Increasing incentives had the most effect on purchase likelihood for LEDs, central air conditioning, and insulation. Incentives that covered more than 50% of the incremental measure cost were associated with the highest increases in reported purchase likelihood; incentives below 50% had a relatively lower effect on willingness-to-pay for these efficient measures.

2 INTRODUCTION

2.1 OVERVIEW

This report presents research results conducted in the state of Pennsylvania by the Statewide Evaluation (SWE) Team of GDS Associates, Nexant, Research Into Action and Apex Analytics as part of a residential baseline study.[10] The baseline energy study's objective is to assess a "market baseline" for the energy efficiency level of existing residential building and equipment stock as well as estimates for the saturation of key energy efficiency and conservation (EE&C) measures for the seven EDCs bound by Act 129.

The seven Electric Distribution Companies (EDCs) represented in this study are:

- Duquesne Light Company (DLC)
- Metropolitan Edison Company (MetEd)
- Pennsylvania Electric Company (Penelec)
- Pennsylvania Power Company (Penn Power)
- West Penn Power Company (WPP)
- PPL Electric Utilities (PPL)
- PECO Energy Company

The SWE Team completed seventy on-site surveys for each of the seven EDCs. In total, the SWE Team conducted 490 residential on-site surveys over a 14-week period in 2013 from late August through mid-November.

2.2 ACT 129 BACKGROUND

Pennsylvania ACT 129 was passed in October of 2008 and signed into law. The Act requires that seven of the state's largest EDCs deliver energy efficiency programs that reduce their electric load.

The Pennsylvania Public Utility Commission (PUC) is currently considering targets for the possible implementation of Phase III of Act 129 starting June 1, 2016. In early 2013, the current Phase II SWE team was selected by the PUC to continue to be the State's Statewide Evaluator. A key element of the SWE Team's scope of work is to conduct an electric energy efficiency market potential study to help inform the implementation of Phase III of Act 129. As a first step in this process, the Phase II SWE team conducted residential, commercial and industrial energy efficiency baseline studies to characterize the energy usage and electric energy efficiency opportunities in the State of Pennsylvania for the seven EDCs bound by Act 129.

The results of the residential sector baseline study are presented within this report. The result of the commercial and industrial sector baseline study are presented in a companion report presented by Nexant.

[10] The SWE Team also utilized two subcontractors: Market Decisions and Mad Dash to assist with the recruitment and fieldwork, respectively.

2.3 STUDY GOALS

While this study's primary aim is to assess current residential electric equipment stock and estimate the saturation of key energy efficiency and conservation measures as eventual inputs to the Phase III energy efficiency market potential study, it is also designed to serve as a stand-alone residential baseline study presenting contemporary information across the seven largest EDCs in Pennsylvania. These results can supply information that is useful for future energy efficiency and demand response program development, and obtaining a general understanding of the energy consuming equipment located throughout the state of Pennsylvania. Based on these ultimate considerations, the following goals were identified for this study:

- Select a representative stratified random sample of residential customers within each EDC for participation in the baseline study
- Determine the current saturation of energy using equipment in residences at the statewide and EDC level
- Determine the current saturation of electric efficiency measures in residences at the statewide level by housing type, as well as at the EDC level

2.4 ORGANIZATION OF THE REPORT

The remainder of this report includes the following sections:

- Section 3 – Study Methodology
- Section 4 – Statewide Residential Findings
- Section 5 – EDC Specific Findings
- Section 6 – Willingness to Pay Research
- Appendices *(On-site Survey Instrument, WTP Survey Instrument, Initial Recruitment Letter, and Recruitment Telephone Script)*

3 METHODOLOGY

3.1 STUDY PARAMETERS

The SWE Team performed on-site surveys from August 2013 through November 2013 to collect detailed and accurate inventories of residential structure and equipment characteristics throughout the state of Pennsylvania. This study captured a variety of energy-related data, including the penetration of electric- and non-electric equipment and appliances, energy efficiency levels of electric equipment and appliances, building shell characteristics, lighting socket counts, and other relevant information.

A total of 490 site surveys stratified by EDC, housing segment, and annual kWh consumption were conducted. The desired level of precision for EDC specific results, ±10% absolute precision, with 90% confidence, necessitated a total of 70 on-site visits per EDC. The data for all EDC's were aggregated to the statewide level, and these estimates carry precision in excess of ±5% absolute precision, with 95% confidence. The sample size was not large enough, nor was it intended, to provide housing segment specific results within each EDC at the 95% level of confidence and 5% margin of error.[11]

3.2 PRIMARY DATA COLLECTION

While each EDC routinely captures important demographic and equipment characteristics in their territory through Residential Appliance Saturation Studies and other targeted studies, there is often a notable absence of data specific to the penetration of energy efficient equipment or data on the energy efficiency level of residential building shells. To overcome this hurdle, the SWE team conducted a survey on a random sample of Pennsylvania residential electric consumers for each EDC to gather accurate data that is specific to Pennsylvania and the seven EDC service territories. In order to maximize the reliability of the survey, the SWE team aimed to gather information through customer site visits.

3.2.1 Sample Design

The target precision and confidence level for the residential on-site survey was ±10% precision, at the 90% confidence interval, for each EDC. To achieve this desired level of precision, a sample of 70 was required for each EDC. To ensure proper representation, the sample was designed to include a broad cross-section of residential customers for each EDC. The samples for each EDC were stratified by home type and average electric consumption. Stratifying on home type and energy use insured representation across all levels of consumption, which in turn ensures representation of other key demographic characteristics (i.e., number of occupants, square footage, heating/cooling equipment type, and other key metrics), without over-burdening the overall stratification and sampling process. To accurately produce a recruitment sample representative of each EDCs current population, it was important to remove non-premise buildings and inactive accounts from each EDC customer database. Ultimately, the SWE team created an intital recruitment sample of 2,100 residences for each EDC. The 2,100

[11] At the statewide level, there were a significant number of observations to make statistically valid conclusions with better than ±10% precision, with 90% confidence for SF-Detached housing, SF-Attached and multifamily housing segments. Results for manufactured housing may only be sufficient to make assumptions at ±15% precision.

recruitment sample mirrored (as closely as possible) the complete residential customer databases of each EDC. While the SWE team only stratified the recruitment sample based on housing type and electric consumption history, the SWE team also verified that the recruitment sample had similar geographic distribution compared to the customer database. In addition, the recruitment sample distribution of home heating type was also compared to the full customer dataset (when available). Recruitment is discussed in further detail later in this section.

The target confidence interval and precision for the residential on-site survey sample for each EDC was a 90% confidence interval with a precision interval of less than 10%. This yielded a final sample size of approximately 70 on-site surveys for each EDC.

With a significantly large population, ±5% precision at the 95% confidence level can generally be achieved with a minimum random sample size of 385 observations. The SWE conducted a total of 490 on-site surveys. Thus, the statewide sample is sufficiently large to produce results at the 95/5 level of confidence and precision.

3.2.2 Recruitment

The first step in the survey process was to design a letter to inform customers in the initial recruitment sample that an energy survey was to be performed in their respective territory and that a SWE team representative would potentially contact them to request participation in the study. The primary recruitment letter was sent out under the name and letterhead of each respective EDC. Next, a phone recruitment script was designed to introduce the study to the residential homeowner, explain the process and demands of the on-site survey and ask for participation.[12] In order to facilitate recruitment, the SWE team was able to offer a $100 incentive to homeowners willing to participate in the survey.

In order to ensure an adequate mix of housing types and electric usage, the SWE team sorted each EDC's recruitment sample of 2,100 residences by housing type and monthly energy usage and divided these residences into 70 select bins per EDC. Once a homeowner in a given bin agreed to the on-site survey, the SWE team did not actively recruit the remaining residences in that bin. This helped to guarantee a final on-site sample that continued to be stratified by both housing type and energy use. Occasionally, if no homeowners within a given bin were able to participate in the study, recruiters would enlist a residential customer from a neighboring bin. The SWE team would attempt to contact customers a maximum of three times before considering an account not part of the study.

The SWE team contacted a total of 6,010 residential consumers across the state and performed a total of 490 site visits with an average recruitment rate of 8.2%.[13] The table below provides a breakdown of the total number of customers contacted and recruited for on-site visits.

[12] A sample copy of the initial recruitment letter for one EDC and the telephone recruitment script for the residential baseline study can be found in Appendix B and C, respectively.

[13] Including cancelled or missed appointments, the recruitment rate increases to 9.1%

Table 3-1: Overall Survey Recruitment Results

EDC	Customers Contacted	Surveys Completed	Recruitment Rate
Duquesne	576	70	12.2%
MetEd	1,207	70	5.8%
Penelec	791	70	8.8%
Penn Power	802	70	8.7%
WPP	827	70	8.5%
PECO	797	70	8.8%
PPL	1,010	70	6.9%
TOTAL	***6,010***	***490***	***8.2%***

3.2.3 On-site Survey

By using an on-site survey instrument and trained staff to review end-use appliances within the home, the data collected is believed to have a high level of accuracy. In order to maximize the effectiveness of each site visit and provide results with a high level of detail, the SWE team designed the on-site survey to be as comprehensive as possible without being overly intrusive to the homeowner. In addition, the 2013 on-site survey form was generally consistent with the survey form utilized for the 2011 PA Residential Baseline Study (also conducted by the SWE) to allow for select comparison of results. This comparison of 2013 and 2011 data can be found in Section 4.8.4 of this report. Last, the SWE team urged EDC personnel and the EDC evaluation teams to review and provide comments on a draft of the survey instrument. The final version of the onsite survey instrument gathers data on the presence of each end-use studied as well as equipment fuel type and efficiency level.

The on-site surveys were completed by thirteen trained site surveyors during a 14-week period from August 2013 through November 2013. In total 490 surveys were completed by the SWE team. Surveyors were equipped with a tablet PC to collect data required by the survey instrument and were typically able to complete each survey within a 2 hour window (excluding the time to travel to and from each site from a central location). To ensure consistent results, the electronic survey form was designed to restrict data entry within selected expected data ranges and was able to confirm the completeness of each survey. A hard copy of the on-site survey instrument is included in Appendix A of this report.

3.2.4 End Uses

The study categorizes energy using equipment in each of the EDC service territories into appropriate end uses. The types of end-uses included in this report are consistent with those typically considered in other regional or national studies. For ease of comparison, the results of this study are presented by end-use in a format consistent with the 2011 PA Residential Baseline Study. The residential end-uses included in this study are:

- Building Envelope
- Heating Equipment
- Cooling Equipment
- Lighting
- Water Heating
- Major Appliances

- Consumer Electronics
- Other

3.3 DATA ANALYSIS

3.3.1 Data Validation & Review

The SWE team reviewed the collected data fields for validity and completeness to ensure data quality across all responses. All fields were scanned for entry errors as well as outliers, enabling the SWE team to address the majority of errors. In addition to entry errors, the SWE team also checked internal consistency in recorded responses across fields. For example, where the number of air source heat pumps did not match between heating and cooling sections, we confirmed system types and corrected fields where possible.

In addition, select missing or questionable data points were cleaned through follow-up phone calls or through publicly available data sources, such as public property records. Finally the make/model numbers of various appliances and HVAC equipment were recorded during the on-site survey to allow for future verification of equipment efficiency. While not all make/model numbers could successfully be located and verified through online databases, the accuracy regarding the saturation of energy efficient appliances and HVAC equipment was significantly upgraded through this practice.[14]

3.3.2 Weighting Factors

Given the different characteristics between single family, multifamily, and manufactured homes, the SWE team developed case weights to control for sample bias within each EDC. Specifically, we calculated sample weights by post-stratifying the sample by building type. The case weights for the EDC-specific results reflect the ratio of the percentage of population to the percentage of the sample.

$W_h = N_h / n_h$

Where:
W = weight
h = housing type
N = percent of total residential accounts for the given building type
n = percent of sample for the given building type

In addition to weighting the EDC-level results by building type, the SWE team also compared selected demographic data collected through the on-site surveys to available data from recent EDC-specific appliance saturation studies and from the US Census.[15] The SWE Team compared the sample to the population on both age of head of household, own vs. rent, and homeowner education variables.

[14] The data cleaning process did not include the reclassification of ENERGY STAR-rated equipment to non-ENERGY STAR if equipment no longer meets updated specifications. This reporting is consistent with the SWE team's expected method for estimated energy efficient technology saturations used in the electric energy efficiency potential study.

[15] U.S. Census: 2011 American Community Survey, 3-Year Estimates

Minimal differences were present between the sample and population datasets, negating the need for any additional weighting schemes.

Table 3-2 shows the case weights for each building type within each EDC. Percent of total residential account estimates for case weights were derived from the 2011 American Community Survey or existing demographic data supplied by EDCs to the SWE Team.

Table 3-2: Survey Weighting for EDC Level Results

% OF RESIDENTIAL CUSTOMERS (by EDC)							
	Duquesne	Met Ed	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	63.4%	62.0%	70.9%	71.9%	70.2%	38.3%	70.4%
SF-Attached	9.5%	17.9%	3.8%	4.6%	5.7%	34.7%	15.3%
Multifamily	25.7%	15.9%	15.9%	16.2%	16.7%	26.1%	9.2%
Manuf./Mobile	1.3%	4.2%	9.5%	7.3%	7.4%	1.0%	5.1%
% OF SAMPLE (by EDC)							
	Duquesne	Met Ed	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	62.9%	64.3%	65.7%	68.6%	64.3%	35.7%	61.4%
SF-Attached	11.4%	17.1%	7.1%	11.4%	11.4%	31.4%	21.4%
Multifamily	24.3%	14.3%	15.7%	11.4%	18.6%	31.4%	11.4%
Manuf./Mobile	1.4%	4.3%	11.4%	8.6%	5.7%	1.4%	5.7%
EDC WEIGHTS							
	Duquesne	Met Ed	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	1.01	0.96	1.08	1.05	1.09	1.07	1.15
SF-Attached	0.84	1.04	0.53	0.40	0.50	1.10	0.71
Multifamily	1.06	1.11	1.01	1.42	0.90	0.83	0.81
Manuf./Mobile	0.93	0.99	0.83	0.85	1.29	0.72	0.89

In an effort to provide a more inclusive study and to provide estimates for each of the EDC territories, a sample of 70 residential sites was selected for each EDC irrespective of the size of the EDC. When aggregating the EDCs estimates to the statewide level, it was necessary to create a second set of case weights to control for differences in the number of residential accounts across the seven EDCs. This approach provides more weight to the data for larger EDCs when compared to smaller EDCs in the statewide findings. The tables below detail the customer counts provided by the individual EDCs as well as the weights that were applied throughout the analysis when rolling up EDC data to statewide findings.

Table 3-3: EDC 2013 Customer Counts

EDC 2013 CUSTOMER COUNT							
Duquesne	Met Ed	Penelec	Penn Power	WPP	PECO	PPL	PA
526,736	487,974	503,617	141,060	619,531	1,445,232	1,231,452	4,955,602
10.6%	9.8%	10.2%	2.8%	12.5%	29.2%	24.8%	-

Table 3-4: Statewide Weights

% OF STATEWIDE CUSTOMERS							
	Duquesne	Met Ed	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	6.7%	6.1%	7.2%	2.0%	8.8%	11.2%	17.5%
SF-Attached	1.0%	1.8%	0.4%	0.1%	0.7%	10.1%	3.8%
Multifamily	2.7%	1.6%	1.6%	0.5%	2.1%	7.6%	2.3%
Manuf./Mobile	0.1%	0.4%	1.0%	0.2%	0.9%	0.3%	1.3%
% OF SAMPLE							
	Duquesne	Met Ed	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	9.0%	9.2%	9.4%	9.8%	9.2%	5.1%	8.8%
SF-Attached	1.6%	2.4%	1.0%	1.6%	1.6%	4.5%	3.1%
Multifamily	3.5%	2.0%	2.2%	1.6%	2.7%	4.5%	1.6%
Manuf./Mobile	0.2%	0.6%	1.6%	1.2%	0.8%	0.2%	0.8%
STATEWIDE WEIGHTS							
	Duquesne	Met Ed	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	0.75	0.67	0.77	0.21	0.96	2.19	1.99
SF-Attached	0.62	0.72	0.37	0.08	0.43	2.25	1.24
Multifamily	0.79	0.77	0.72	0.28	0.79	1.69	1.40
Manuf./Mobile	0.69	0.68	0.59	0.17	1.13	1.48	1.55

3.3.3 Penetration vs. Saturation

This report frequently sites two metrics: penetration and saturation. These metrics merit further explanation.

Penetration refers to the proportion of households that have one or more of a particular appliance (or other piece of equipment). It is calculated by dividing the number of customers with one or more of an appliance (or other piece of equipment) by the total number of surveys with responses to that question. For instance, computers in the PPL service area have a penetration of 86%. This means 86% of all homes have at least one PC (though they could have more than one).

Saturation refers to the number of particular appliance or piece of equipment per household. It is calculated by dividing the total number of a particular appliance/equipment by the total number of surveys with responses to that question. This percentage is typically higher than the corresponding penetration because some households will have more than one of the appliances (except lighting).[16] For instance, a computer saturation of 156% in the PPL territory indicates that, on average, there are 1.56 computers in residential households.

While saturations indicate the average number of units across all households (including households that do not have the equipment), a third metric, mean units, tells us the average number of units for households with at least one unit. Dividing saturation by the penetration gives us the mean units. In the computer example for PPL above, while the saturation of computers is 156%, only 86% of the

[16] Lighting saturation refers to the proportion of lighting represented by the given bulb type. For this reason, lighting saturation is lower than or equal to its corresponding penetration.

households have at least one computer. This indicates that of the households that have at least one computer, there are, on average, 1.81 computers.

3.3.4 Significance Testing

Due to budget and time constraints, statistical testing was conducted only for a few select variables to determine if the estimates (proportion or mean) for a given metric were significantly different across samples or across specific groups within one sample. To test for differences between means derived from two independent samples (such as the average number of efficient bulbs per home in 2011 vs. 2013) the t-Test was utilized. To test for differences between two proportions (such as the proportion of Energy Star refrigerators in owned homes vs. rented homes), the Chi-squared test was employed. All t-Tests and Chi-squared tests were computed at the 0.05 significance level (i.e., $\alpha = .05$).

3.4 UNCERTAINTY

The survey estimates presented in this report are subject to a certain degree of uncertainty. Practical constraints make it impossible for the SWE team to conduct an on-site survey for the entire population of Pennsylvania residences, necessitating the selection of a small sample population from which to collect data. When using a sample to estimate a population metric, factors of uncertainty are introduced, primarily based on the size of the sample and the existence of biases within the sample.

The uncertainty can be described by the confidence level and margin of error, targeted in this study at 95% and 5%, respectively, for the state-wide residential sector. This means that if this study were repeated multiple times, 95% of the studies would produce estimates to within ±5% of the true population value. The sample size required to achieve these levels of confidence with a large population is given in the Equation 3.1.

Equation 3-1: Sample Size Determination

$$n = \frac{Z^2 \times (p)(1-p)}{d^2}$$

Where:
n = Sample size
Z = Value for selected confidence level, 95% corresponds to 1.96
p = Expected proportion of responses. Maximum possible proportion of 0.5 yields maximum sample size
d = Margin of error, 0.05

Based on this equation, the minimum sample size required to achieve precisions of ±5%, at 95% confidence, is 384. The SWE team's targeted sample size of 490 customers is sufficiently large to achieve this level of confidence. As can be shown by the equation above, a sample size greater than 384 will result in an increased level of confidence and a smaller margin of error.

With considerations for sample size it is important to note that the more aggregated findings in this report have the highest confidence, while the confidence decreases as results become more disaggregated (either by housing type or EDC). For example, if 283 customers out of 490 residential sample points across the state have central air conditioning systems, the penetration of central air

conditioning can be reported with a confidence/precision level of greater than 95/5 due to the sample of 490 data points (well in excess of 384). Likewise if 41 customers out of 70 sample points in an EDC territory have central air conditioning, the penetration of central air condition can be reported with a confidence/precision level of approximately 90/10. However, the percent of central cooling systems that are of a particular efficiency level will have greater uncertainty because the sample size of central cooling is only 41. Additionally, the amount of uncertainty increases when developing estimates of particular metrics at the housing type level due to the limited sample points. When attempting to analyze the survey responses by EDC and by housing type, the sample sizes became very small; therefore, results at the EDC level were not broken out by housing type. Additionally, while results at the statewide level are disaggregated by housing type, the level of confidence/precision differs by housing type since some segments received fewer observations than others (e.g. single family-attached homes only have 76 observations statewide).

Due to differences in the overall mix of equipment within each home, it was not possible to collect data for every characteristic at every site. For example, while all homes have water heating, only a fraction of them are electric water heaters. This report notes when field-specific sample sizes have a limited number of observations. To assist the reader in identifying the level of certainty associated with each finding, we have included sample sizes for all metrics, even when the number of observations is extremely limited. However, when the number of observations falls below 17, the level of confidence/precision falls below 90/20, and we caution against making any statistical inferences based on such a small sample.

While on-site surveys are generally able to achieve more accurate and detailed datasets than self-reported or telephone surveys, it was not possible to collect data for all data fields at all locations. One example is that the make/model number for an end use may have been transcribed incorrectly, was not legible, or the equipment was of significant age, and product data was no longer available from the manufacturer. In other cases, central water heating or HVAC systems may have been inaccessible at rented multi-family unit properties. For these instances, an “Unknown” field was specified. The SWE team has included “Unknown” responses in our analysis where meaningful; otherwise, we present the percentages after eliminating these unknown responses. The SWE team has also attempted to consistently note where the exclusion of “Unknown” responses has resulted in a limited sample size.

Finally, another factor that can influence the accuracy of the results is the extent to which the sample is representative of the population as a whole. Though stratified samples were selected randomly, it is possible that the sample contains some type of bias which can influence results. The SWE was able to verify that the residential sample was consistent with population level data across a variety of data variables (home ownership, age of head of household, housing type, etc.), but notes that differences between the sample and population could still exist.

In addition to uncertainty due to sample size or random sampling error, other forms of uncertainty may occur during on-site survey collection. This report includes a brief statistical comparison of the 2013 dataset with the 2011 PA Residential Baseline survey data. Although the SWE team attempted to make the 2013 collected data fields consisted with the 2011 data collection instrument, the type and/or granularity of data was occasionally altered. As an example, the 2013 survey instrument adjusted and included additional data fields associated with residential duct systems. As a result, a direct comparison

with the 2011 data is problematic and it is difficult to determine whether these are actual differences in the assessment of duct sealing over the two datasets.

Where possible, the SWE team took steps to ensure biases were minimized in the samples given the time and budget constraints allotted. Samples were selected randomly from each EDC's customer database in a manner which eliminated the potential for human error or other biases. The SWE team stratified the recruitment sample to calibrate the 70 on-site surveys based on a known mix of housing types and energy consumption. The SWE team attempted to minimize the potential for systematic uncertainty through consistent surveyor training and data collection materials. By taking these steps, the SWE team believes that the results of the survey can be used to make reasonable assumptions about the characteristics of the overall customer base of the EDCs included in this study.

4 STATEWIDE RESIDENTIAL FINDINGS

4.1 INTRODUCTION

This section describes the residential sector findings obtained from the on-site survey collection and analysis activities at the statewide level. As noted in section 3.3.2, statewide results were weighted by EDC to control for differences in the number of residential accounts across the seven EDCs. This approach provides more weight to the data for larger EDCs when compared to smaller EDCs in the statewide findings.

When all data fields were available, statewide results are based on a total of 490 observations.[17] The total number of observations by housing type is as follows: SF-Detached houses (296), SF-Attached (78), multifamily (89), and manufactured housing (27). Statistical level of confidence falls to 90/15 at 30 observations and 90/20 at 17 observations. Note that throughout this section, number of manufactured housing observations was small enough and the SWE team does not recommend using for statistically reasonable conclusions. Total sample sizes for all metrics have been noted throughout.[18]

4.2 BASIC HOME CHARACTERISTICS

4.2.1 Usage

As noted earlier in the report, each EDC provided the SWE team with 2012 historical billing data for the pool of potential on-site survey recruits. The potential residential recruits were then stratified by average monthly kWh consumption and home type and recruited to attain a representative sample of each EDC territory in terms of average monthly usage and housing type. Table 4-1 shows the representation of electric usage weighted for statewide level results.

Table 4-1: Distribution of Average Monthly Electricity Usage by Statewide Weights

Occupants	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
<=500 kWh	19%	30%	49%	24%	26%
501-1000 kWh	38%	49%	32%	35%	39%
1001-1500 kWh	28%	15%	8%	31%	22%
>1500 kWh	16%	6%	10%	10%	13%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

4.2.2 Home Type

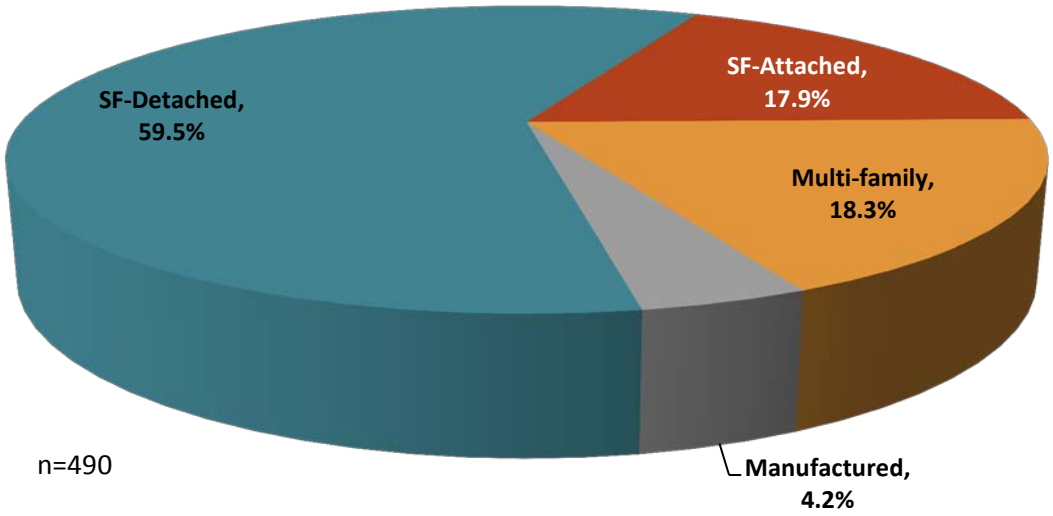
Figure 4-1 displays the types of residential sites weighted to represent the statewide proportion of housing stock. Single family detached houses are the dominant housing type (59.5%). Single family

[17] In the data tables presented throughout this section, "Statewide" refers to all housing types combined.

[18] To reduce confusion and the appearance of non-integer site visit counts, sample sizes (n) throughout the report reflect the number of observations prior to any weighting factors.

attached houses consisting of row houses, townhomes, and duplexes represent 17.9%. Multifamily units, such as apartments and condos, represent an additional 18.3%. Finally, manufactured housing/mobile homes represent approximately 4% of the residential housing units.

Figure 4-1: Home Type by Statewide Weights



Home Age. The average age of the home was 55 years. Table 4-2 displays the distribution of the years of construction. Approximately 52% of housing was built between 1950 and 2000. Only 16% of the total existing housing stock was built after 2000.

Table 4-2: Average Age of Home by Statewide Weights

Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Average Age	54	55	71	21	55
n	288	76	63	27	454

Table 4-3: Year of Construction by Statewide Weights

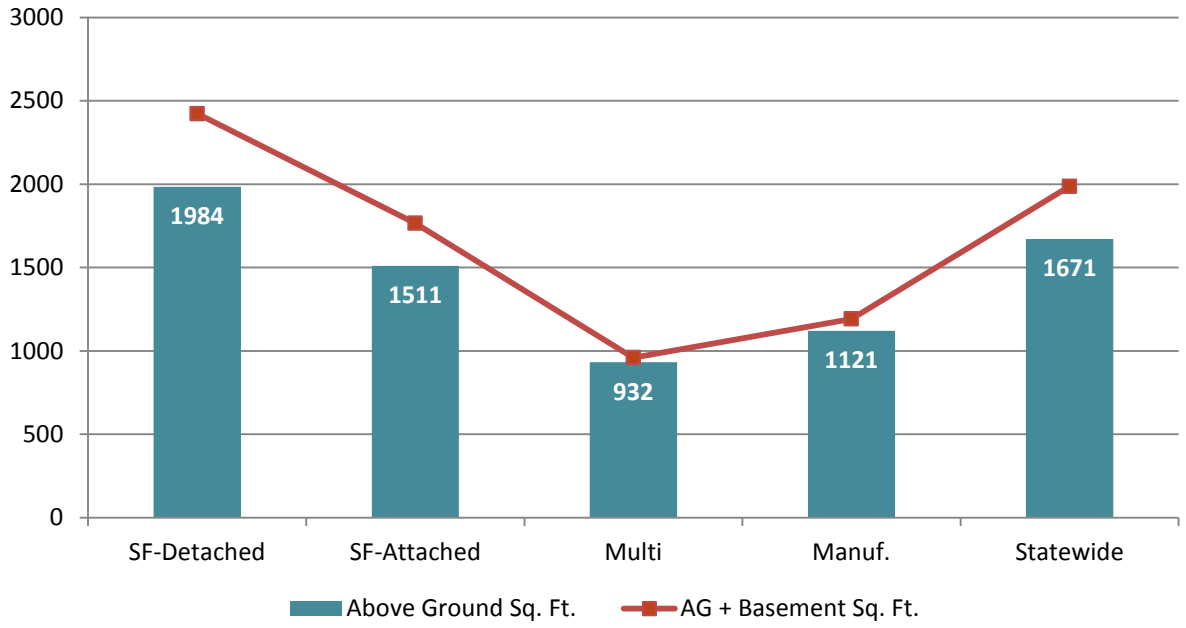
Year of Construction	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Pre 1920	13.8%	26.2%	27.7%	0.0%	17.4%
1920-1929	4.8%	1.3%	8.6%	0.0%	4.5%
1930-1939	4.9%	5.9%	11.7%	0.0%	5.8%
1940-1949	5.3%	1.2%	5.8%	0.0%	4.3%
1950-1959	19.5%	5.9%	11.0%	0.0%	14.9%
1960-1969	5.4%	5.4%	3.9%	4.5%	5.2%
1970-1979	12.9%	10.7%	7.7%	15.7%	11.9%
1980-1989	7.5%	16.2%	13.3%	26.7%	10.8%

Year of Construction	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
1990-1999	9.0%	14.0%	2.8%	11.5%	9.1%
2000-2009	14.6%	12.0%	7.2%	36.2%	14.0%
2010 - Present	2.3%	1.1%	0.4%	5.5%	2.0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	288	76	63	27	454

4.2.3 Home Size & Foundation

The average square footage of above ground space for all housing was approximately 1,671 square feet. Total square footage increased to 1,987 sq. ft. after accounting for conditioned basements. Single family detached housing square footage was approximately 1,984 square feet without conditioned basements and 2,423 with conditioned basements. SF-Attached, multifamily, and manufactured homes' total conditioned square footage (including conditioned basements) ranged from roughly 960 sq. ft. to 1,766 sq. ft. However these conditioned space area estimates for housing types other than SF-detached are based on a limited number of observations (n=55 or less).

Figure 4-2: Average Home Square Footage (Conditioned Space) by Statewide Weights



Home Foundation. The majority of housing units have conditioned or unconditioned basements. A crawl space was generally only found in manufactured homes and slab on-grade foundations were relatively uncommon, particularly in SF-Detached residences. Occasionally homes shared a mixture of foundation types (e.g. partial basement/crawlspace, crawlspace/slab, etc.). These homes were designated as a "mixed" foundation.

Table 4-4: Foundation Type by Statewide Weights

Foundation Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Slab	4%	15%	18%	3%	8%
Crawlspace	3%	2%	1%	90%	6%
Basement	78%	76%	30%	7%	66%
Mix	15%	7%	4%	0%	11%
Over Apartment Unit	0%	1%	47%	0%	9%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

Table 4-5: Basement Type by Statewide Weights

Foundation Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Cond. /Uncond. Mix	8%	4%	1%	0%	6%
Conditioned Basement	36%	21%	6%	7%	27%
Unconditioned Basement	34%	51%	23%	0%	34%
No Basement	22%	24%	70%	93%	34%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

4.2.4 Demographics

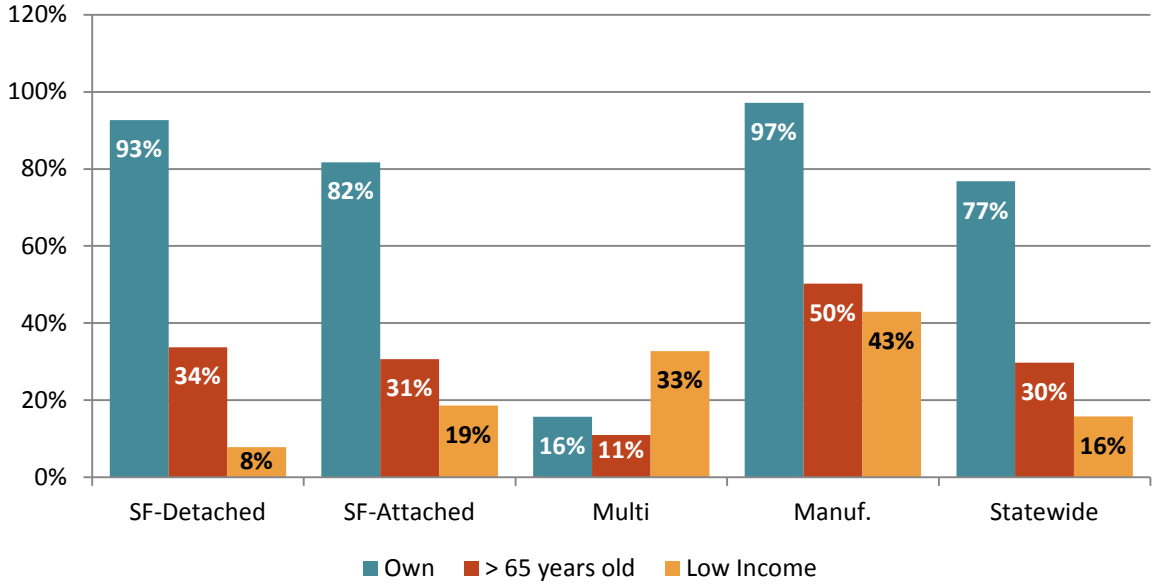
Homeownership. Approximately 77% of all surveyed houses were considered to be owner-occupied. All housing types, with the exception of multifamily units, were predominately owned. In contrast, only 84% of multifamily units were rental units.

Age of Head of Household. Approximately 30% of the head of households were 65 years of age, or older. Multifamily homes were least likely to have a head of household age 65 or above.

Income. Approximately 16% of surveyed households were identified as low-income households by the EDCs.[19] Manufactured homes, multifamily units, and SF-Attached residences were more likely to be designated as low-income relative to the statewide average, while only 8% of SF-Detached homes were identified as low-income households in the EDC databases.

[19] Low income status was assigned based on "known" low income households designated in the individual EDC customer databases, and may underestimate the actual percent of low income households in the sample. Due to sensitivity concerns, household income was not asked during the on-site assessments.

Figure 4-3 Select Demographics by Statewide Weights



Note: All three demographic variables are based on the full dataset of 490 responses.

Type of Residence. Nearly all of surveyed homes are year-round, primary residences.

Table 4-6: Year Round Residences by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Year-Round	97%	97%	100%	100%	98%
n	296	78	89	27	490

Occupancy. The average year-round home occupancy was approximately 2.4 persons per household, statewide.

Table 4-7: Number of Year Round Occupants by Statewide Weights

Occupants	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Avg. # of Occupants	2.4	3.2	1.9	1.7	2.4
Max. # of Occupants	9	7	7	7	9
Min. # of Occupants	1	1	1	1	1
n	296	78	89	27	490

4.3 BUILDING SHELL

4.3.1 Insulation

Attic Insulation. The majority of surveyed homes had some level of attic insulation present. Less than 10% of homes statewide were verified to have no attic insulation present. Surveyors were unable to verify the presence or absence of insulation in 26% of homes. This was largely the case in multifamily units where access to attic space is limited or not available.

Table 4-8: Presence of Attic Insulation by Statewide Weights

Insulation Present?	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Yes	78%	50%	24%	72%	63%
No	9%	9%	12%	2%	9%
No Attic	0%	3%	11%	0%	3%
Unknown	14%	38%	53%	26%	26%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	292	88	90	21	490

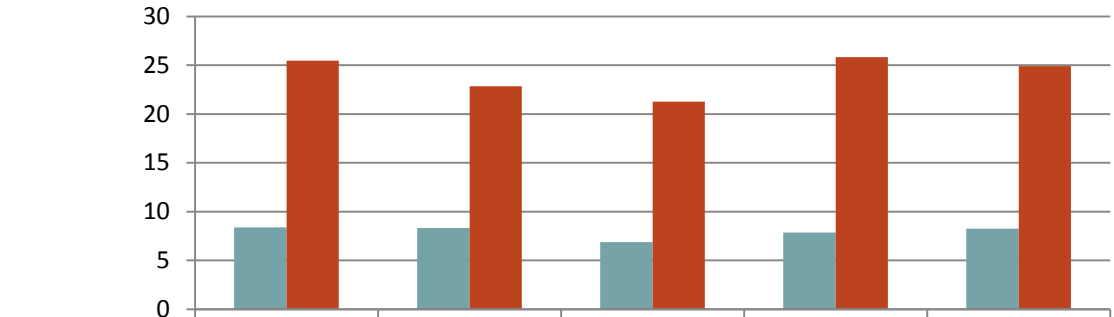
Attic Insulation Type. Fiberglass is the predominant form of attic insulation, when insulation is present. Fiberglass batting or loose-fill fiberglass was present in 74% of surveyed attics with insulation. Note that not all attics were able to be inspected and verified to possess attic insulation.

Table 4-9: Type of Attic Insulation by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Cellulose Loose	14%	15%	22%	11%	15%
Fiberglass Batt	52%	28%	54%	52%	49%
Fiberglass Loose	25%	39%	15%	11%	25%
Other	4%	0%	0%	1%	3%
Unknown	5%	19%	9%	25%	8%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	234	47	23	18	322

Attic Insulation Thickness. The average thickness of attic insulation was 8.0 inches. The average insulation R-value, after accounting for thickness and insulation type, was R-25. Due to limited access to attics, particularly in multifamily units, attic insulation thickness was not determined in all instances where attic insulation was present.

Figure 4-4: Attic Insulation Thickness/R-value by Statewide Weights



	SF-Detached	SF-Attached	Multi	Manuf.	Statewide
Thickness (in.)	8	8	7	8	8
R-value	25	23	21	26	25

n	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n (Thickness)	202	34	14	13	263
n (R-value)	198	32	14	14	258

For homes where attic insulation was present and insulation levels assessed, the table below indicates the proportion of insulation by R-value. 23% of homes, statewide, had less than R-19 insulation located in their attics. 16% of homes had R-38 or greater. The majority of homes (62%) had at least R-19 but less than R-38 insulation.

Table 4-10: Proportion of Attic Insulation R-Value by Statewide Weights

R-value Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
R1-R12	10%	6%	5%	7%	9%
R13-R18	13%	28%	5%	2%	14%
R19-R37	60%	61%	88%	63%	62%
R38-R59	14%	4%	2%	28%	13%
R60+	3%	1%	0%	0%	3%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	198	32	14	14	258

Wall Insulation. The majority of surveyed homes had some level of wall insulation present. Statewide, 19% of homes were verified to have no wall insulation present. Surveyors were unable to verify the presence or absence of insulation in 29% of homes. N/A refers to homes where wall insulation was not applicable.

Table 4-11: Presence of Wall Insulation by Statewide Weights

Insulation Present?	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Yes	61%	37%	26%	84%	51%
No	20%	20%	20%	2%	19%
N/A	0%	0%	3%	0%	1%
Unknown	20%	42%	52%	14%	29%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	292	88	90	21	490

Wall Insulation Type. Fiberglass batting is the predominant form of wall insulation (72%). Surveyors were not able to determine the type of insulation in 12% of instances. Note that not all homes had wall insulation present and the number of total observations outside of SF-detached homes is limited.

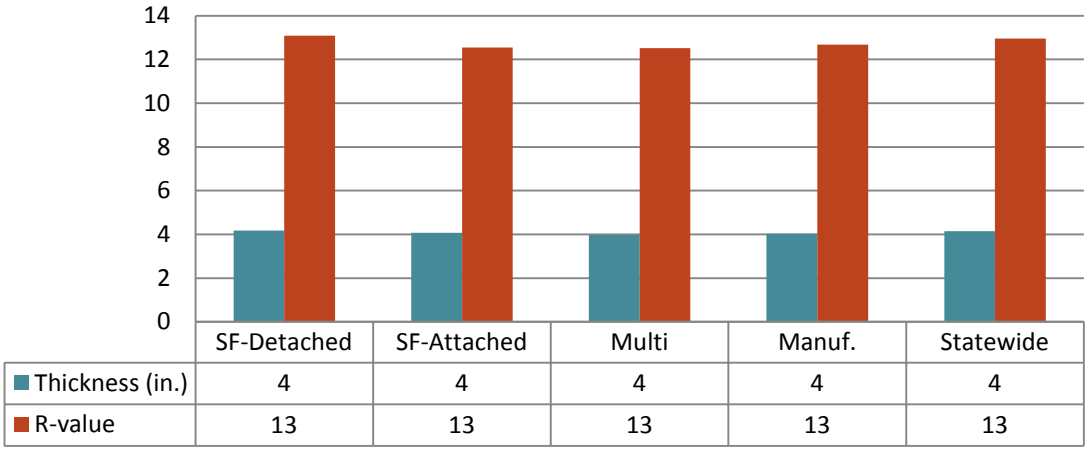
Table 4-12: Type of Wall Insulation by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Cellulose Loose	8%	0%	0%	0%	6%
Fiberglass Batt	73%	68%	71%	73%	72%

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Fiberglass Loose	7%	0%	3%	1%	5%
Other	6%	6%	5%	0%	6%
Unknown	7%	27%	21%	26%	12%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	186	42	30	22	280

Wall Insulation Thickness. The average thickness of wall insulation was 4 inches. The average insulation R-value, after accounting for thickness and insulation type, was R-13. Due to limited access to wall space, particularly in multifamily units and SF-Attached units, wall insulation thickness was not determined in all instances where wall insulation was present.

Figure 4-5 Wall Insulation Thickness/R-value by Statewide Weights



n	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n (Thickness)	176	31	22	18	247
n (R-value)	173	30	21	18	242

For homes with wall insulation, the table below indicates the proportion of insulation by insulation R-value. 51% of homes, statewide, had less than R-13 insulation located in their walls. An additional 46% of homes with wall insulation have between R-13 and R-18 wall insulation. Only 3% of homes with wall insulation exceed R-19.

Table 4-13: Proportion of Wall Insulation R-value by Statewide Weights

R-value Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
R1-R12	47%	67%	62%	56%	51%
R13-R18	51%	31%	29%	44%	46%
R19-R37	3%	3%	10%	0%	3%

R-value Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	173	30	21	18	242

Basement Wall/Foundation Wall/Frame Floor Insulation. Based on the results of surveyed homes with basements and/or crawlspaces, 42% of homes had either basement/foundation wall or frame floor insulation in their homes. 49% of surveyed homes with basements and/or crawlspaces did not possess insulation in either location, and the presence of insulation could not be verified in 10% of basement/crawlspace homes.

Table 4-14: Presence of Basement/Foundation Wall or Frame Floor Insulation by Statewide Weights

Insulation Present?	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Yes	45%	25%	22%	89%	42%
No	47%	69%	45%	0%	49%
Unknown	8%	6%	33%	11%	10%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	287	62	27	26	402

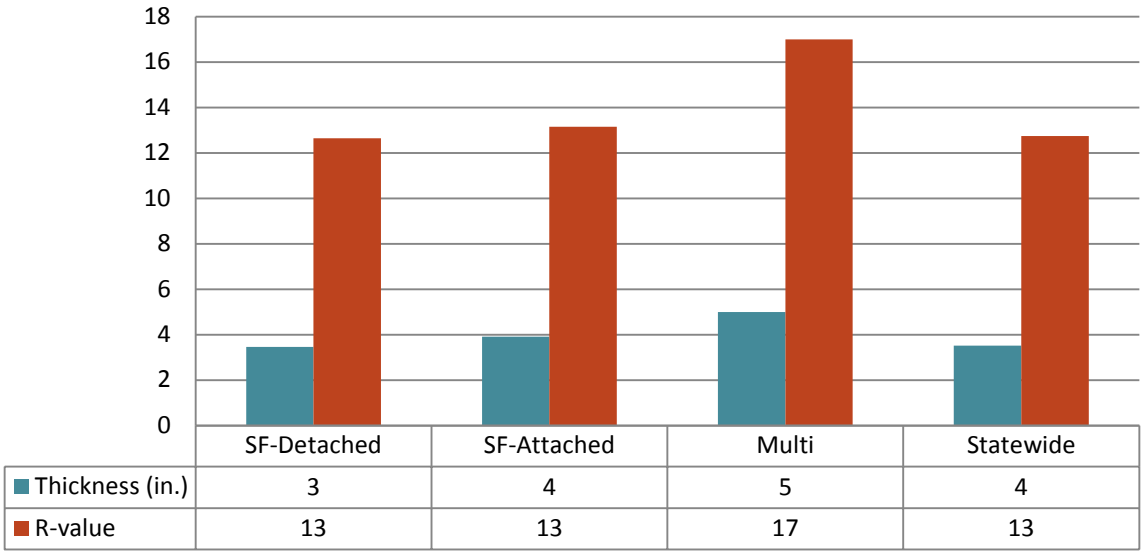
Basement Wall Insulation Type. When basement wall insulation is present, fiberglass batting is the predominant form of basement wall insulation (50%). Rigid board insulation is also fairly common (19%). Note the limited number of observations available where basement wall insulation was present for all housing types outside of SF-Detached housing units. These limited observations restrict the level of confidence of reported statistics.

Table 4-15: Basement Wall Insulation Type by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Statewide
Fiberglass Batt	50%	53%	51%	50%
Fiberglass Loose Fill	3%	0%	0%	3%
Rigid Board	21%	0%	0%	19%
Other	13%	15%	49%	14%
Unknown	13%	31%	0%	14%
Grand Total	**100%**	**100%**	**100%**	**100%**
n	83	13	2	98

Basement Wall Insulation Thickness. In surveyed homes with basement wall insulation, the average thickness of insulation is 4 inches. The average insulation R-value of basement wall insulation, after accounting for thickness and insulation type, was R13. Note the limited number of observations available for basement wall insulation based on both the overall number of homes with basement wall insulation present as well as surveyor ability to determine thickness and R-value in these homes. These limited observations restrict the level of confidence of reported statistics.

Figure 4-6: Basement Wall Insulation Thickness/R-value by Statewide Weights



n	SF-Detached	SF-Attached	Multifamily	Statewide
n (Thickness)	64	7	1	72
n (R-value)	61	7	1	69

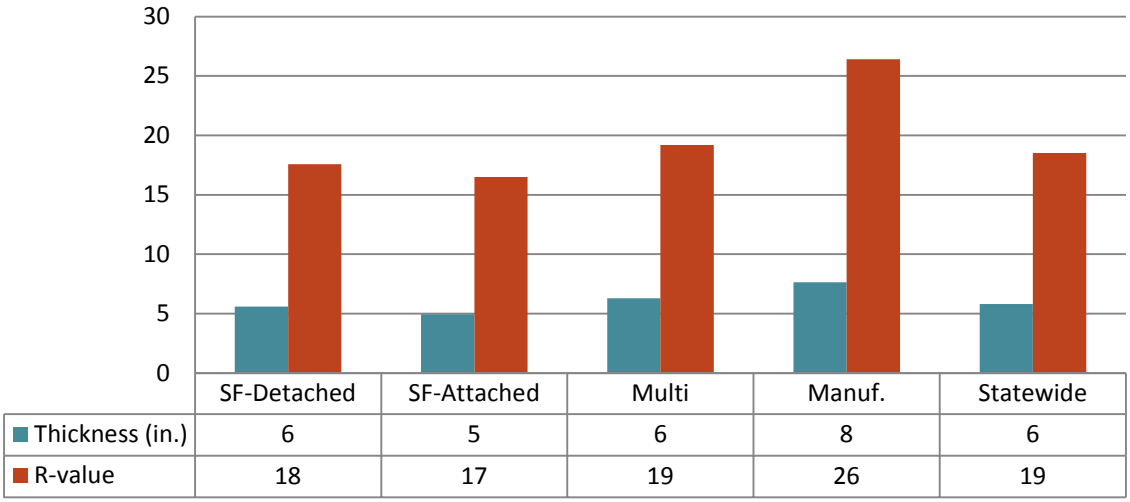
Floor Insulation Type. Fiberglass batting is the predominant form of floor insulation (87%). Note that only a subset of the surveyed homes possesses floor insulation either because they did not possess basements and/or crawlspace, or insulation was not present. As a result, the number of observations available for this metric is limited from the complete dataset.

Table 4-16: Floor Insulation Type by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Fiberglass Batt	88%	100%	87%	74%	87%
Other	5%	0%	0%	8%	5%
Unknown	7%	0%	13%	17%	8%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	91	12	5	22	130

Floor Insulation Thickness. In surveyed homes with floor insulation present, the average thickness of floor insulation was 6 inches. The average insulation R-value, after accounting for thickness and insulation type, was R19. The total number of observations is limited as not all homes were candidates for floor insulation, and surveyors were not able to determine thickness and R-value at all site visits.

Figure 4-7: Floor Insulation Thickness/R-value by Statewide Weights



n	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n (Thickness)	78	11	4	17	110
n (R-value)	73	11	4	16	104

For homes with floor insulation installed and where surveyors were able to determine average thickness and R-value, slightly more than half (56%) currently meet or exceed the R-19 level; 21% fall below R-13.

Table 4-17: Proportion of Floor Insulation R-value by Statewide Weights

R-value Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
R1-R12	25%	8%	27%	8%	21%
R13-R18	21%	51%	32%	1%	23%
R19-R37	51%	41%	41%	61%	50%
R38-R59	3%	0%	0%	30%	6%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	77	11	4	16	108

4.3.2 Windows

Number of windows. The average number of windows per surveyed household was approximately 16 windows. SF-Detached housing averaged 20 windows per household statewide. The remaining housing types averaged slightly lower number of windows per residence. The minimum number of windows in a residence was 1; the maximum was 76.

Table 4-18: Average Number of Windows per Household by Statewide Weights

# of Windows	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Avg. # of Windows	20	12	7	12	16
Max. # of Windows	76	27	31	19	76
Min. # of Windows	2	1	1	6	0
n	296	78	89	27	490

Total Window Area. The average total square footage of window glazing area for all households statewide was nearly 170 sq. ft. per household. SF-Detached houses averaged roughly 200 sq. ft. per residence.

Table 4-19: Average Area of Window Glazing per Household by Statewide Weights

Avg. Window Area	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Square Feet	202	136	91	145	168
n	296	78	89	27	490

Glazing Type. The table below describes the glazing types present at the surveyed homes. The majority of windows were double-paned. Roughly 2% of windows are triple-paned across all housing types statewide. 9% of all windows are still single-paned across all housing types statewide. Where surveyors were unable to confirm the existence of low-E coating, windows were assumed to be standard double-paned.

Table 4-20: Window Glazing Type by Statewide Weights

% of Windows	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Single-paned	9%	8%	8%	22%	9%
Double-paned	61%	74%	89%	60%	65%
Low-E double-paned	28%	13%	1%	17%	24%
Triple-paned	2%	5%	2%	2%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n (windows)	5943	875	624	322	7764

4.3.1 Roofs

Roof Color. The majority of surveyed homes have dark roofs (69%). The remainder of surveyed homes had mostly light colored roofs, with only very small percent (2%) having reflective roofs.

Table 4-21: Roof Color by Statewide Weights

Color	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Dark Color	70%	75%	65%	55%	69%
Light Color	28%	24%	30%	24%	27%
Reflective	2%	0%	6%	21%	3%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**

n	295	78	79	27	479

4.3.2 Air Sealing

Air Sealing. Air Sealing was assessed qualitatively by surveyors by checking for possible areas of leakage around doors, windows, recessed cans, and other gaps in the thermal envelope. Surveyed homes were assessed as either: well-sealed, partially sealed, or poorly sealed. Less than one-fifth of surveyed homes (18%) were assessed as poorly sealed. The majority of homes (45%) were assessed as partially sealed, with 34% of homes assessed as well-sealed. Surveyors were unable to assess in approximately 4% of housing statewide.

Table 4-22: Quality of Air Sealing by Statewide Weights

Air Seal Qual.	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Well Sealed	38%	35%	20%	26%	34%
Partially Sealed	44%	38%	51%	47%	45%
Poorly Sealed	16%	23%	18%	18%	18%
Unable to Assess	2%	3%	10%	9%	4%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

4.3.3 Duct Sealing

Duct Location. Where ducts were present, more than half of the ductwork was located in unconditioned space (typically basements, crawlspaces, and/or attics) in approximately 30% of the surveyed homes. Ninety percent or more of ductwork was located in conditioned space in 53% of homes. Statewide, 77% of the ductwork located outside of conditioned space was found in unconditioned basements, 18% in attics, and the remaining 5% in crawlspaces.

Responses were omitted when the surveyor was unable to confirm the location of the ductwork; the final number of observations (n) is included below.

Table 4-23: Duct Location by Statewide Weights

Duct Location	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
< 50% Conditioned	31%	27%	25%	56%	30%
50%-90% Cond.	16%	21%	16%	5%	17%
>90% Cond.	53%	52%	59%	39%	53%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	222	61	36	15	334

Table 4-24: Unconditioned Space Duct Location by Statewide Weights

Duct Location	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Attic	18%	11%	42%	17%	18%

Duct Location	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Crawl space	1%	5%	0%	76%	5%
Uncond. basement	81%	84%	58%	7%	77%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	155	41	16	11	223

Duct Insulation. Where ductwork was located outside of conditioned space, surveyors recorded the level of duct insulation present in the home. 58% of ductwork located in unconditioned space had R-4 insulation or less. 31% of ductwork in unconditioned space had between R-4 and R-7. Again, note that these observations are limited to homes with ductwork in unconditioned space and where the surveyor was able to confirm the level of insulation; the final number of observations (n) is included below.

Table 4-25: Unconditioned Space Duct Insulation Level by Statewide Weights

Insulation Level	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Less than R-4	52%	76%	57%	14%	58%
R-4 – R-7	37%	18%	28%	32%	31%
R-8 or greater	12%	6%	15%	54%	11%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	165	47	17	7	236

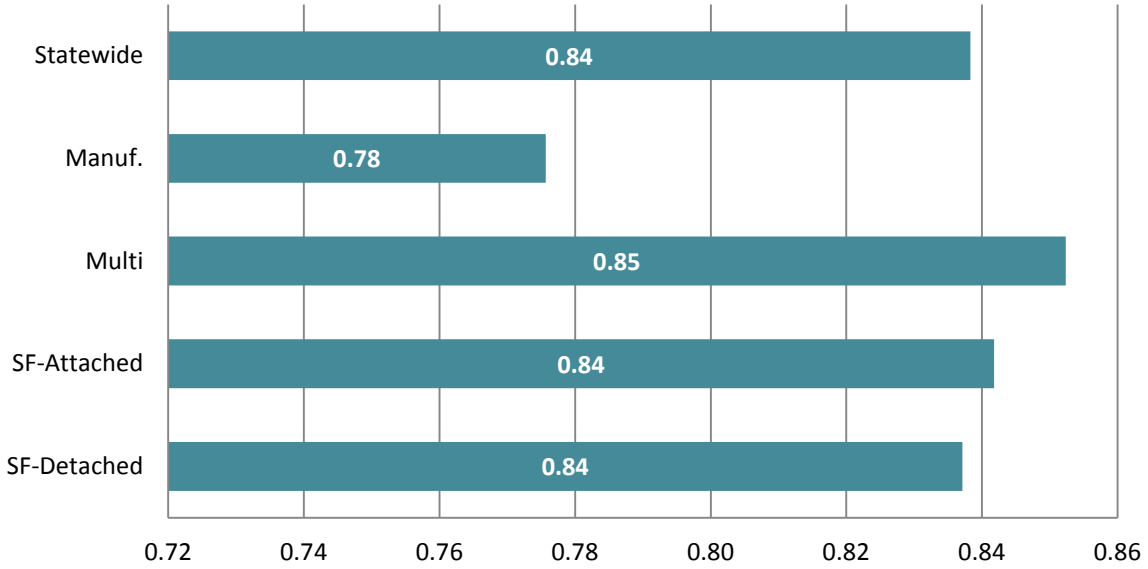
Duct Sealing. The table below presents a qualitative assessment of duct sealing in homes with existing ductwork. 41% of homes with existing ductwork were assessed to have some or significant observable leaks while only 23% were observed to be correctly sealed with mastic. No observable leaks were found in the remaining 35% of homes in the qualitative assessment.

Table 4-26: Quality of Duct Sealing by Statewide Weights

Duct Seal Qual.	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Sealed with Mastic	21%	27%	22%	67%	23%
No observable leaks	39%	26%	37%	6%	35%
Some observable leaks	38%	47%	36%	27%	39%
Significant leaks	2%	0%	5%	0%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	219	59	34	10	322

In addition to the qualitative assessment, the surveyors combined three of the data fields (% within conditioned space, insulation on ductwork located outside the conditioned space, and the qualitative assessment of air sealing) to create an index of duct efficiency. This index was modeled after the Building Performance Institute's Distribution Efficiency Look-Up Table. The calculated distribution efficiency of the duct systems are provided below

Figure 4-8: Distribution Efficiency of Ductwork by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	214	59	31	10	314

4.4 RESIDENTIAL HVAC

This section presents details on the residential space heating and cooling systems present at the surveyed homes.

4.4.1 Space Heating & Cooling Combination

Heating & Cooling Equipment Combination. The table below presents the space heating and space cooing equipment combinations present in households statewide. Households with primary non-electric heating systems and central AC cooling are the most common statewide (38% of households). An additional 29% of households have primary non-electric heat with Room AC cooling. Homes with primary electric heat are most likely to have central AC units (13% of households statewide).

Table 4-27: Heating & Cooling Equipment Combination by Statewide Weights

H & C Combo	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
NON-ELECTRIC HEATING					
Central AC Only	46%	30%	21%	35%	38%
Room AC Only	23%	43%	35%	35%	29%
CAC & RAC	6%	3%	1%	0%	4%
No Cooling	7%	2%	6%	8%	6%
ELECTRIC HEATING					
Central AC Only	10%	20%	18%	7%	13%
Room AC Only	4%	2%	16%	7%	6%

H & C Combo	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
CAC & RAC	1%	0%	0%	8%	1%
No Cooling	2%	0%	3%	0%	2%
n	295	78	87	27	487

4.4.2 Space Heating

Primary Fuel Type. Natural gas was the most prominent heating fuel found in residential homes (51%) statewide. Electric and oil systems were also fairly common across housing types. The saturation of electric primary heating systems was approximately 22% of all households. The remaining space heating fuel types include coal, propane, wood, etc.

Table 4-28: Fuel Type of Primary Space Heating Systems by Statewide Weights

Prim. Fuel Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Natural Gas	50%	59%	55%	9%	51%
Electric	17%	23%	36%	22%	22%
Coal	3%	0%	0%	3%	2%
Dual Fuel	1%	0%	0%	0%	1%
Kerosene	0%	0%	2%	6%	1%
Oil	19%	18%	7%	32%	17%
Propane	6%	0%	0%	25%	5%
Wood	3%	0%	0%	3%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	295	78	89	27	489

Secondary Fuel Type. For homes with secondary heating systems that utilize a different fuel type than the primary system, the most common secondary fuel type is electric. However, note the small sample size in all housing types outside of SF-Detached. These limited observations do not meet a reasonable level of statistical confidence.

Table 4-29: Fuel Type of Secondary Space Heating Systems by Statewide Weights

Second. Fuel Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Natural Gas	10%	0%	0%	0%	9%
Electric	54%	89%	61%	0%	54%
Coal	1%	0%	0%	0%	1%
Oil	4%	11%	0%	0%	4%
Propane	12%	0%	39%	26%	13%
Wood	19%	0%	0%	74%	19%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	76	3	3	3	85

Primary System Type. 53% of primary heating systems are central furnaces regardless of fuel type. The next most common systems are boilers and heat pump systems.

Table 4-30: System Type of Primary Space Heating Systems by Statewide Weights

Prim. System Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Central Furnaces	53%	63%	38%	86%	53%
Boilers	24%	20%	22%	8%	22%
Heat Pumps	10%	15%	4%	0%	9%
Baseboard	6%	1%	13%	0%	6%
Other	1%	1%	16%	0%	4%
Space Heaters	1%	0%	7%	1%	2%
Stoves	5%	0%	0%	6%	3%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	295	78	89	27	489

Primary Electric Heating System Type. Heat Pumps are the most common form of primary electric heating systems (42%) statewide. Baseboard heating and electric furnaces are also common systems in primary electric heated homes (26% and 21%, respectively). Other electric systems include portable space heaters and unknown system types.

Figure 4-9: Statewide System Types for Primary Electrically Heated Homes

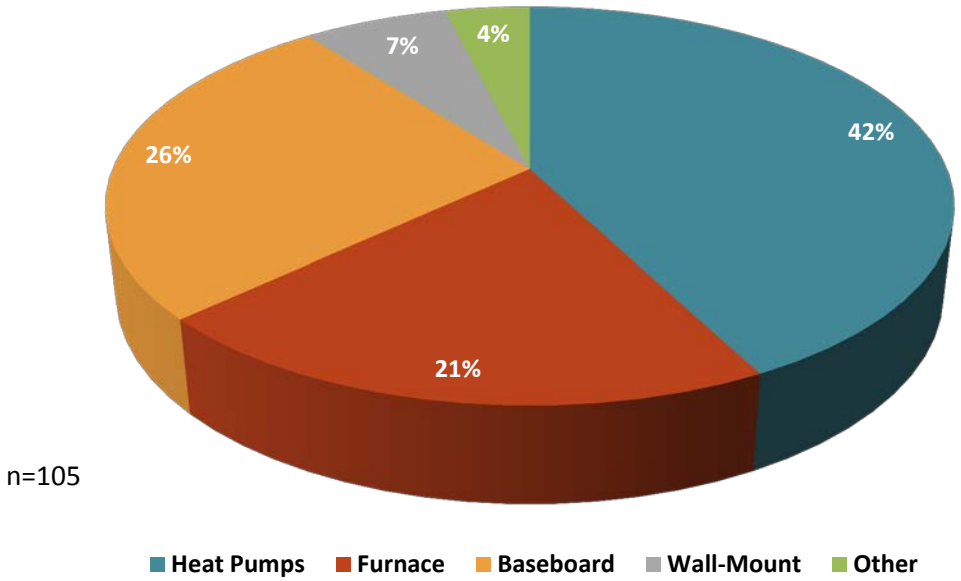


Table 4-31: System Type of Primary Electric Heating Systems by Statewide Weights

Prim. Electric Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Air Source HP	44%	65%	5%	0%	35%
Geothermal HP	7%	0%	0%	0%	3%
Dual Fuel HP	5%	0%	0%	0%	3%
Ductless HP	0%	0%	5%	0%	2%
Baseboard	31%	6%	35%	0%	26%
Furnace	6%	26%	31%	96%	21%
Wall Mounted Space	0%	0%	13%	0%	4%
Other	6%	4%	10%	4%	7%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	51	17	30	7	105

Secondary System Type. Statewide, baseboard heating systems were the most common form of secondary heat system (32%), followed by wall mounted systems, and wood stoves. Due to the small number of homes with back-up space heating, the number of observations for this data is limited for data outside of SF-Detached homes.

Table 4-32: System Type of Secondary Space Heating Systems by Statewide Weights

Second. System Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Air Source HP	7%	0%	0%	0%	6%
Baseboard	32%	21%	61%	0%	32%
Boiler (Water)	4%	11%	0%	0%	4%
Ductless HP	4%	67%	0%	0%	6%
Furnace	7%	0%	0%	26%	7%
Other	10%	0%	39%	0%	11%
Wall Mounted Space	16%	0%	0%	0%	14%
Wood Stove	20%	0%	0%	74%	20%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	75	3	3	3	84

Heating System Age. The average heating system is 15 years old. System age is fairly consistent across housing types.[20]

Table 4-33: Average Heating System Age by Statewide Weights

Avg. Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Years	15	12	15	12	15
n	397	83	60	20	559

[20] Equipment age for HVAC units, and other major appliances, was typically reported by the homeowner.

Approximately 30% of all heating systems were estimated by homeowners to be 20 years of age or older. Only 17% were estimated to be less than 5 years old.

Table 4-34: HVAC System Age Range by Statewide Weights

HVAC Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	17%	22%	8%	22%	17%
5-9 Years	20%	29%	19%	29%	22%
10-14 Years	20%	19%	20%	17%	19%
15-19 Years	10%	9%	33%	14%	12%
20 Years or Older	34%	21%	20%	18%	30%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	397	83	60	20	559

Heating Maintenance. The majority of homeowners reported that they had recently (within the last 2 years) had a seasonal tune-up performed on their heating systems. However, an additional 31% statewide reported they had never had a seasonal tune-up performed on their heating systems.

Table 4-35: Time since Last Seasonal Tune-Up (Heating Systems) by Statewide Weights

HVAC Last Tuned?	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Equip. < 1 year old	2%	8%	1%	0%	3%
Less than 1 year	36%	35%	35%	42%	36%
1-2 years	25%	18%	25%	24%	24%
More than 2 years	5%	11%	3%	8%	6%
Never (Repair Only)	31%	28%	36%	25%	31%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	283	76	60	26	445

4.4.3 Space Cooling

Penetration of Central Air Conditioning (AC) Systems. Statewide, 56% of households have at least one central air conditioning unit (includes heat pumps and mini-split systems). Across housing types, SF-Detached homes were most likely to have at least one central air conditioning system (63% of SF-Detached homes). In contrast, multifamily units were least likely to have a central air conditioning system, at 38%.

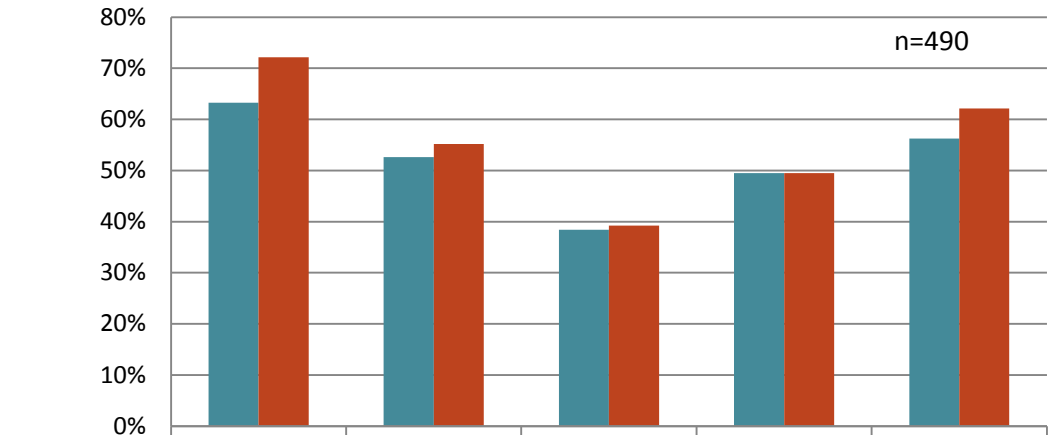
Table 4-36: Penetration of Central AC Systems by Statewide Weights

# CAC	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0	37%	47%	62%	51%	44%
1	55%	50%	38%	49%	51%
2	7%	3%	1%	0%	5%

# CAC	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
3	1%	0%	0%	0%	1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

Saturation of Central AC Systems. Few homes had more than one central air conditioning system, statewide. After accounting for homes with multiple central air conditioning systems, the saturation of central air conditioning, statewide is 62%

Figure 4-10 Saturation of Central AC Systems by Statewide Weights



	SF-Detached	SF-Attached	Multi	Manuf.	Statewide
Penetration	63%	53%	38%	49%	56%
Saturation	72%	55%	39%	49%	62%

Central AC System Type. While traditional Central AC systems are the predominant system type for cooling 78% statewide), heat pumps also account for 17% of central cooling systems.

Table 4-37: Central Air Conditioning System Type by Statewide Weights

Central AC Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Central AC	78%	69%	86%	87%	78%
GSHP	2%	0%	0%	0%	1%
Heat Pump	17%	26%	5%	13%	17%
Ductless AC	2%	0%	0%	0%	1%
Ductless HP	1%	5%	5%	0%	2%
Other	0%	0%	4%	0%	1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	209	49	37	11	306

Central AC SEER Rating. The Central AC energy efficiency level was infrequently provided on the equipment, but where the make and model were available the SWE team recorded and researched manufacturer data. A large portion of Central AC systems had a SEER rating below current federal minimum standards (SEER 13).[21] Only 9% of all Central AC systems (including heat pumps, geothermal and mini split systems statewide met current ENERGY STAR criteria of 14.5 SEER or better.

Table 4-38: Central AC System SEER Ratings by Statewide Weights

SEER Rating	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Below 13	47%	32%	14%	28%	40%
13	20%	34%	9%	17%	21%
14	8%	5%	0%	7%	7%
14.5 or above	10%	12%	3%	2%	9%
Unknown	15%	18%	74%	47%	23%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	208	49	35	11	303

For those Central AC units with a designated SEER rating below 13, the large majority of systems were classified as SEER 10 (77%of systems below 13; 31% of all systems). Also note that this table also includes the Central AC systems where the SEER rating was unable to be determined. It is probably that a majority of these unknown systems are currently at or below the current minimum standard as manufacturer data was often unavailable for older systems.

Central AC System Age. The average central cooling system (including heat pumps) is 10 years old.

Table 4-39: Average Central AC System Age by Statewide Weights

Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Average (Years)	10	9	10	9	10
n	186	44	18	11	259

The table below presents the age range of central AC systems surveyed statewide. Overall, 22% of installed systems are more than 15 years old, while roughly one-quarter are estimated to be less than 5 years old.

Table 4-40: Central AC System Age Range by Statewide Weights

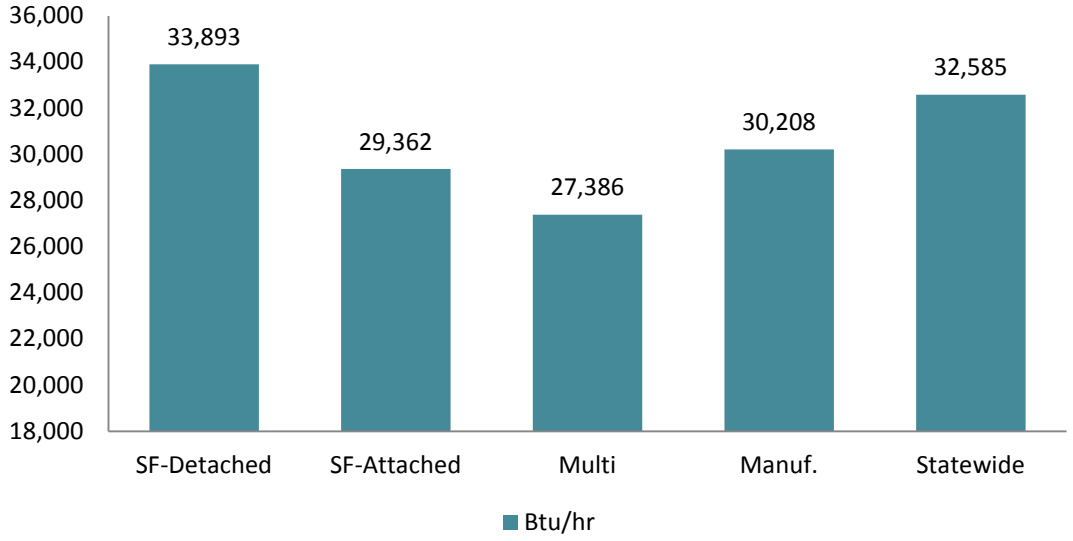
AC Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	23%	35%	14%	13%	24%
5-9 Years	28%	31%	25%	54%	29%
10-14 Years	26%	17%	30%	28%	25%
15-19 Years	10%	5%	23%	6%	10%
20 Years or Older	14%	11%	7%	0%	12%

[21] Of those Central AC units with a SEER rating below 13, the large majority of systems were classified as SEER 10

AC Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	186	44	18	11	259

AC Capacity. The average cooling capacity of central cooling systems (including heat pumps) in homes statewide was roughly 32,600 Btu/hr. SF-Detached homes averaged slightly larger systems than the statewide average and multifamily units averaged smaller size AC systems (between 2 and 2.5 ton systems).

Figure 4-11 Average Central AC Capacity by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	183	42	22	6	253

AC System Maintenance. The majority of homeowners reported that they had recently (within the last two years) had a seasonal tune-up performed on their AC system. Similar to heating seasonal tune-ups, roughly 29% of households statewide reported they had never had a seasonal tune-up performed on their AC systems.

Table 4-41: Time since Last Seasonal Tune-Up (Cooling Systems) by Statewide Weights

HVAC Last Tuned?	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Equipment < 1 yo	3%	8%	0%	0%	3%
Less than 1 year	38%	50%	46%	43%	41%
1-2 years	21%	15%	16%	19%	20%
More than 2 years	10%	2%	3%	8%	8%
Never (Repair Only)	29%	25%	35%	30%	29%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

HVAC Last Tuned?	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	187	48	35	11	281

Penetration of Room AC Systems. Statewide, 41% of homes have at least one room air conditioning system. Whereas SF-Detached homes are most likely to have a central air conditioning system, they are least likely, relative to the other housing types, to possess room air conditioning systems. Statewide, only 34% of SF-Detached homes have one room air conditioner or more. Across the other housing types, roughly one-half of homes have at least one room air conditioner.

Table 4-42: Penetration of Room Air Conditioners by Statewide Weights

# RAC	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0	66%	53%	46%	50%	59%
1	13%	12%	32%	27%	17%
2	10%	20%	17%	20%	14%
3+	11%	16%	5%	3%	10%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

Saturation of Room AC Systems. As suggested above, the overall saturation for room air conditioning is lowest in SF-Detached housing. Statewide, the saturation of room air conditioners is 72%.

Table 4-43: Saturation of Room Air Conditioners by Statewide Weights

Saturation	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Room AC	67%	86%	73%	84%	72%
n	296	78	89	27	490

Room AC Age. The average age of room air conditioning units is 7.

Table 4-44: Average Age of Room Air Conditioning Units by Statewide Weights

Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Average (Years)	7	7	7	5	7
n	154	55	52	23	284

Table 4-45: Room Air Conditioning Unit Age Range by Statewide Weights

Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	39%	20%	48%	57%	38%
5-9 Years	32%	63%	13%	30%	34%
10-14 Years	18%	12%	21%	9%	16%

Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
15-19 Years	7%	0%	12%	4%	6%
20 Years or Older	5%	5%	6%	0%	5%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	154	55	52	23	284

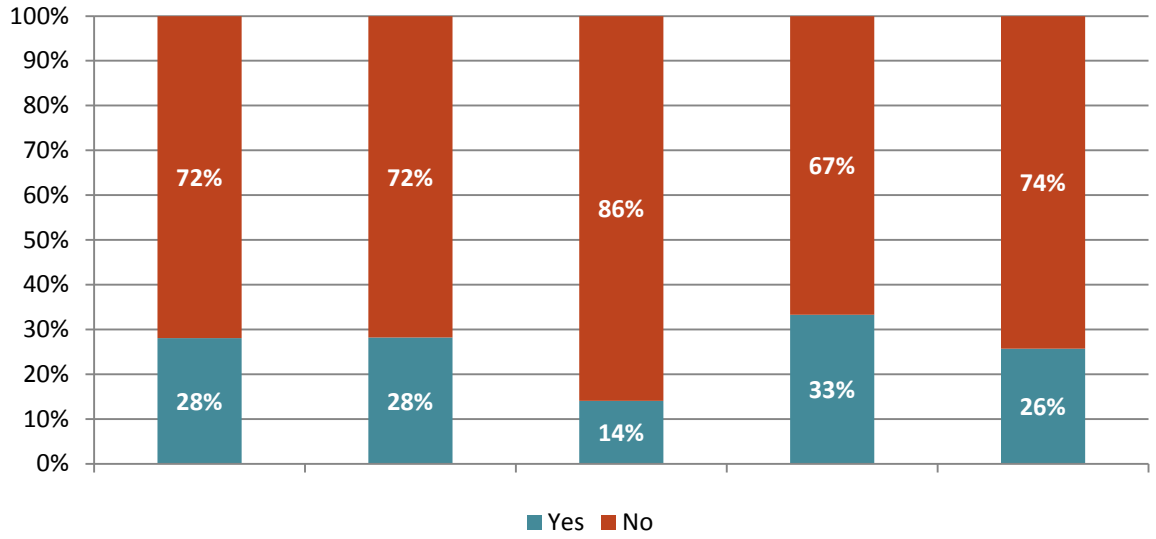
Room AC Capacity. Statewide, the average cooling capacity of room air conditioning units was approximately 8,000 btu/hr. SF-Detached and manufactured homes averaged slightly higher capacity units while units SF-Attached and multifamily homes had slightly lower cooling capacities.

Table 4-46: Average Cooling Capacity of Room Air Conditioning Units by Statewide Weights

Capacity	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Average (Btu/hr)	8,231	7,234	6,949	9,437	7,870
n	153	57	52	19	281

ENERGY STAR Room Air Conditioners. 26% of room air conditioners were ENERGY STAR rated statewide. The SWE team documentation of ENERGY STAR Room ACs was based on the ability to visually detect the label or determine that a particular model was ENERGY STAR rated by searching for the make and model number on the ENERGY STAR website or manufacturer data. The number of room air conditioners with make/model number detail available is listed to demonstrate the limited sample size associated with this metric for housing types other than SF-Detached.

Figure 4-12: ENERGY STAR Room Air Conditioners by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	187	69	69	25	350

4.4.4 Other

Programmable Thermostats. 54% of Central AC systems statewide had a programmable thermostat installed. Multifamily and manufactured homes were less likely to have programmable thermostats than single-family homes. Homes without central AC systems were not included in this metric.

Table 4-47: Programmable Thermostats by Statewide Weights

Prog. Thermostat	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
No	40%	37%	77%	75%	46%
Yes	60%	63%	23%	25%	54%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	187	48	34	11	280

Thermostat Set-Points. Statewide, homeowners set their thermostat during the heating season to 67 – 69° Fahrenheit. During the cooling season, the AC thermostat was set to between 73-75° Fahrenheit. While away from home, homeowners generally lowered their thermostat during the heating season to reduce heating times and raised their thermostat during the cooling season to reduce cooling times.

Figure 4-13: Heating and Cooling Thermostat Set Points (Degrees Fahrenheit) - Statewide

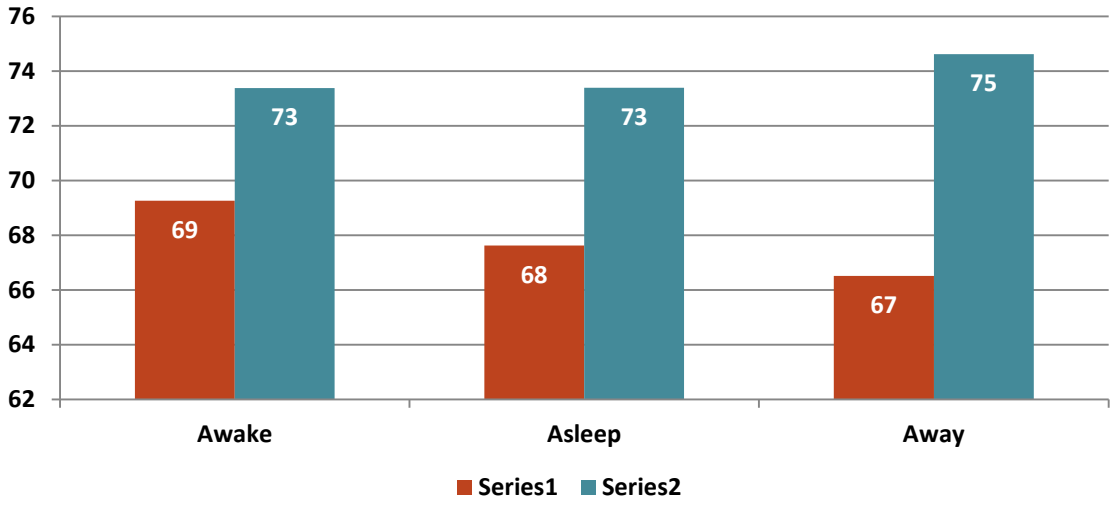


Table 4-48: Cooling System Temperature Set Points by Statewide Weights

HVAC Set Points	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
HEATING					
Awake	69	70	70	69	69
Asleep	67	69	69	69	68
Away	66	67	68	68	67
n	271	76	72	22	441
COOLING					
Awake	74	73	72	74	73

HVAC Set Points	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Asleep	74	73	72	74	73
Away	75	74	73	74	75
n	165	51	43	9	268

4.5 LIGHTING

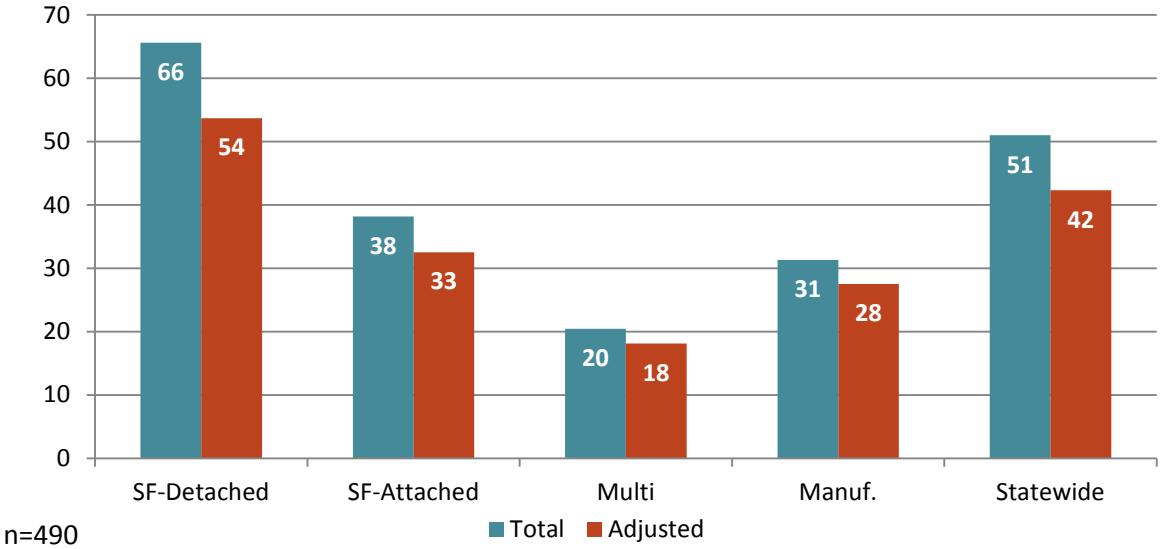
This section presents details on the lighting equipment used in the surveyed residential sites.

4.5.1 Sockets per Home

Interior Sockets per Home. The average number of interior lighting sockets per home is 51 total sockets. These include all Edison-base, candelabra, pin-based and empty sockets found in homes and conditioned spaces. Exterior lighting is not included in this socket count. SF-Detached homes averaged 66 sockets statewide, with fewer sockets across the remaining housing types.

Adjusted Interior Sockets per Home. After accounting for empty lighting sockets[22], tube fluorescent lighting, specialized sockets (i.e. neon lights, xenon, zircon gas), and pin-based lighting, the total number of sockets per home reduces to an average of 42 sockets per home statewide. This socket count aims to represent the total number of sockets eligible for CFL placement by removing sockets where CFL bulbs are unlikely or cannot easily be retrofitted.

Figure 4-14: Number of Total and Adjust Interior Sockets per Home by Statewide Weights



[22] Although many empty lighting sockets could theoretically receive CFL/LED lighting, these sockets were excluded from the adjusted socket count in order to reflect sockets where CFL/LED lighting either has replaced, or could replace existing inefficient bulbs. The exclusion of empty sockets from the adjusted socket count was also consistent with the 2011 PA Statewide Residential End-Use & Saturation Study. Empty sockets accounted for less than 1% of all sockets statewide.

Exterior Sockets per Home. The average number of exterior lighting sockets per home is 5 sockets.

Adjusted Exterior Sockets per Home. The average number of adjusted exterior lighting sockets per home is 5 sockets. Adjusted exterior sockets exclude pin-based sockets, sockets with no installed bulb, and unknown bulb/socket types.

Table 4-49: Exterior Sockets per Home by Statewide Weights

Number of Sockets	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Total Ext. Sockets/Home	8	3	2	3	5
Adj. Ext. Sockets/Home	7	2	1	3	5
n	296	78	89	27	490

4.5.2 Bulb Type

Penetrations by Interior Bulb Type. The table below presents the penetration of interior lighting by bulb type. Nearly all homes have incandescent lighting. At least one compact fluorescent light (CFL) bulb can be found in 89% of residences. Modified Halogen, found in only 5% of households, refers to the general purpose halogen bulbs that meet EISA standards. Tube fluorescent lighting is found in approximately two-thirds of most residences. General halogen bulbs are found in 32% of all residences statewide. LEDs (including nightlights) are currently found in less than 10% of all homes. Other bulbs include empty sockets with no bulbs present.

Table 4-50: Penetration of Lighting by Interior Bulb Type by Statewide Weights

Bulb Type (Penetration)	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Incandescent	100%	99%	96%	87%	99%
CFL	93%	81%	82%	90%	89%
LED	23%	11%	4%	4%	17%
Modified Halogen	6%	3%	2%	0%	5%
Halogen	41%	28%	10%	21%	32%
Tube Fluorescent	79%	58%	45%	51%	68%
Other	15%	9%	8%	14%	12%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

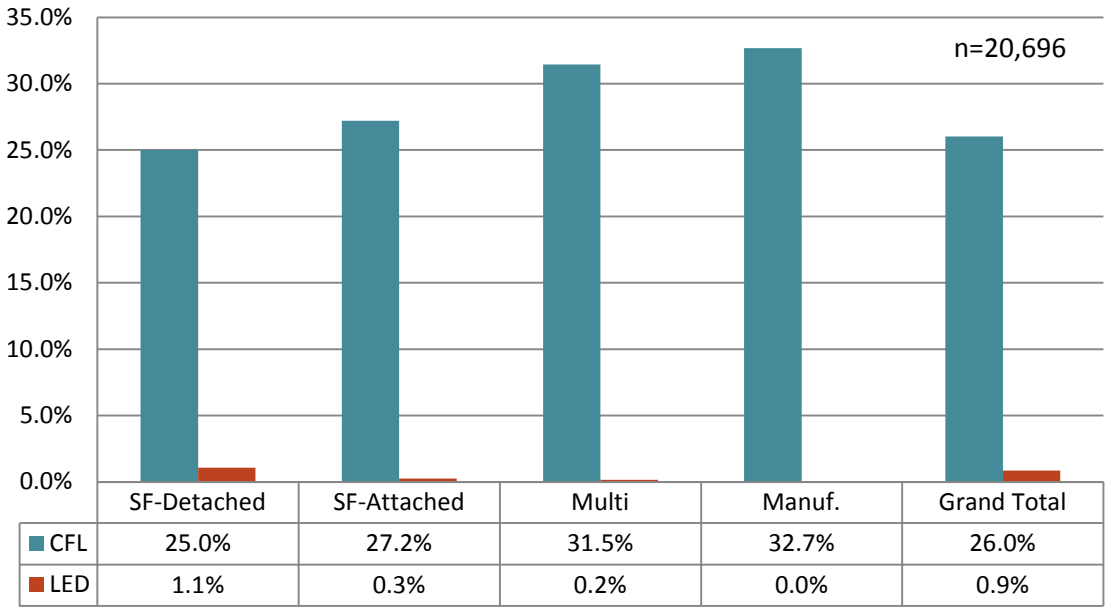
Saturations by Interior Bulb Type. Incandescent bulbs account for 59% of all sockets in residences throughout Pennsylvania. While CFLs can be found in 89% of houses, CFL bulbs only account for 22% of all sockets. Tube fluorescent and halogen bulbs make the dominant majority of remaining sockets. Note that while LED lighting can be found in 23% of single family-detached housing, the saturation of LED lighting relative to all bulbs in single family detached housing is only approximately 3%.

Table 4-51: Saturation of Lighting by Interior Bulb Type by Statewide Weights

Bulb Type (Saturation)	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Incandescent	58%	61%	60%	62%	59%
CFL	21%	23%	28%	29%	22%
LED	3%	1%	0%	0%	2%
Modified Halogen	0%	0%	0%	0%	0%
Halogen	6%	4%	1%	2%	5%
Tube Fluorescent	12%	10%	8%	7%	12%
Other	1%	1%	1%	0%	1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	19172	3133	1880	776	24961

CFL/LED Saturations based on Adjusted Interior Sockets. The figure below presents the saturation of CFL and LED bulbs as a percent of sockets where high efficiency lighting could reasonably be achieved and excludes sockets where CFL/LED placement would be difficult or unrealistic. Under these conditions, the saturation of CFL lighting increases to 26% statewide.

Figure 4-15: CFL/LED Saturations based on Eligible Interior Sockets by Statewide Weights



	SF-Detached	SF-Attached	Multi	Manuf.	Grand Total
CFL	25.0%	27.2%	31.5%	32.7%	26.0%
LED	1.1%	0.3%	0.2%	0.0%	0.9%

Standard vs. Specialty Bulbs. In sockets where high efficiency lighting could reasonably be achieved, 72% of bulbs are considered standard, 17% are specialty, and 11% are reflector/flood bulbs. In this analysis, standard bulbs refer to medium-base A-lamp and medium-base candle-shape bulbs. Specialty bulbs refer to candelabra/small screw base, globe, bullet, and other shapes other than A-lamp bulbs.

Table 4-52: Standard vs. Specialty Bulbs by Statewide Weights

Bulb (Saturation)	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Reflector	12%	10%	4%	2%	11%
Specialty	18%	17%	13%	17%	17%
Standard	71%	73%	83%	81%	72%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	15699	2659	1643	695	20696

The saturation of high efficient lighting (CFL & LED bulbs) among standard, specialty, and reflector bulbs is shown below. In the homes survey, standard bulbs were much more likely to be efficient than specialty and reflector bulbs.

Table 4-53: Efficient (CFL/LED) Lighting in Standard vs. Specialty Bulbs by Statewide Weights

% High Efficiency	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Reflector	12%	11%	7%	0%	11%
Specialty	4%	6%	0%	2%	4%
Standard	33%	35%	38%	39%	34%
n	15699	2659	1643	695	20696

CFL/LED Saturations by Adjusted Exterior Sockets. CFL and LED bulbs represent 20.9% (18.9% and 2%, respectively) of exterior sockets where high efficiency lighting could reasonably be achieved and excludes sockets where CFL/LED placement would be difficult or unrealistic.

Table 4-54: Saturation of Lighting by Exterior Bulb Type by Statewide Weights

Bulb Type (Saturation)	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
CFL	17.1%	25.9%	31.6%	32.5%	18.9%
LED	2.3%	0.8%	0.0%	0.0%	2.0%
n	**1924**	**213**	**98**	**90**	**2325**

4.5.3 Bulb Wattage

Average Wattage by Interior Bulb Type. The table below presents the average wattage of interior lighting by bulb type. The average wattage of incandescent bulbs was 56W, suggesting a heavier mix of 40W and 60W bulbs than 75W to 100W bulbs in interior sockets. The average wattage of CFL bulbs was 16W. The number of observations listed refers to CFL bulbs only. There were significantly greater numbers of incandescent bulbs statewide, and significantly less halogen, modified halogens, and LED bulbs.

Table 4-55: Average Wattage by Bulb Type by Statewide Weights

Avg. Wattage	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
CFL	16	16	16	14	16
Halogen	50	50	55	69	51

Avg. Wattage	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Incandescent	55	59	57	51	56
LED	7	8	11	20	7
Modified Halogen	50	55	58	n/a	51
Tube Fluorescent	38	37	35	35	38
n (for CFL Wattage)	3807	761	502	248	5318

4.5.4 Lighting Saturations by Room

Socket by Room Type. Statewide, the most common location of lighting was found in bedrooms, followed closely by other high and medium use areas such as bathrooms, basements, kitchens, and living rooms. Closets, garages, utility rooms and other are common low daily use areas, and represent 11% of interior sockets.

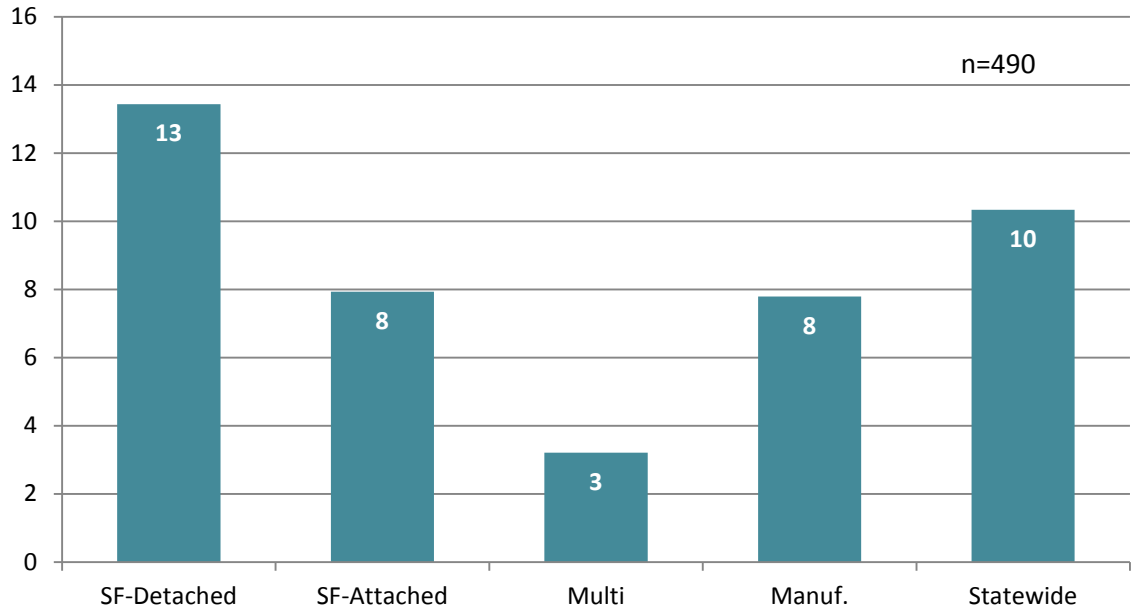
Table 4-56: Interior Socket Saturation by Room Type by Statewide Weights

Room Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Bathroom	14%	17%	18%	20%	15%
Bedroom	16%	19%	21%	18%	17%
Closet	3%	3%	3%	2%	3%
Dining Room	7%	7%	8%	7%	7%
Foyer/Hallway	10%	10%	9%	6%	10%
Garage	5%	2%	0%	4%	4%
Kitchen	12%	12%	14%	15%	12%
Living Room	10%	13%	18%	17%	11%
Media/Bonus Room	3%	1%	0%	0%	2%
Office/Den	4%	4%	3%	3%	4%
Other	2%	1%	0%	4%	2%
Unfinished Basement/Attic	11%	9%	4%	2%	10%
Utility Room	2%	2%	1%	1%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	19172	3133	1880	776	24961

4.5.5 Bulbs in Storage

Average Number of Bulbs in Storage. Statewide, the average number of bulbs that homeowners held in storage was 10 bulbs. SF-Detached homes averaged the most bulbs in storage per household (10 bulbs), while multifamily units averaged the least number of bulbs in storage (3 bulbs).

Figure 4-16: Average Number of Bulbs in Storage by Statewide Weights



Bulbs in Storage by Quantity Bin. Statewide, 66% of homes had held less than 10 bulbs in storage, and 84% of homes held less than 20 bulbs. In contrast, only 4% had 50 or more bulbs in storage at the time on the on-site surveys.

Table 4-57: Quantity Range of Bulbs in Storage by Statewide Weights

Qty Bins	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-9 bulbs	56%	74%	89%	65%	66%
10-19 bulbs	21%	12%	11%	26%	18%
20-29 bulbs	10%	7%	0%	9%	7%
30-39 bulbs	6%	4%	0%	0%	4%
40-49 bulbs	2%	0%	0%	0%	1%
50+ bulbs	6%	3%	0%	0%	4%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

Storage bulbs by Bulb Type. The majority of bulbs in storage were found to be incandescent bulbs, 67% statewide. 28% of bulbs in storage were CFL bulbs, and less than one percent was LED bulbs. Few storage bulbs were halogens, modified halogens, or tube fluorescent lights.

Table 4-58: Type of Bulbs in Storage by Statewide Weights

Bulb Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Incandescent	59%	67%	62%	66%	61%

Bulb Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
CFL	35%	30%	31%	28%	35%
LED	1%	0%	2%	0%	0%
Halogen	3%	1%	3%	4%	2%
Modified Halogen	2%	1%	0%	1%	0%
Tube Fluorescent	1%	1%	1%	0%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	4039	571	319	176	5105

4.6 DOMESTIC WATER HEATING

4.6.1 Equipment Saturations by Fuel/Type

Water Heating Fuel Type. Natural gas is the most prevalent fuel source for water heating purposes across all housing types and statewide (46%). Electric water heating is almost equally common, found in 43% of housing statewide. Oil water heating is a distant third, found in only 7% of surveyed houses statewide. Other fuels for water heating were found in less than 1% of surveyed households.

Figure 4-17: Water Heating Fuel Type - Statewide

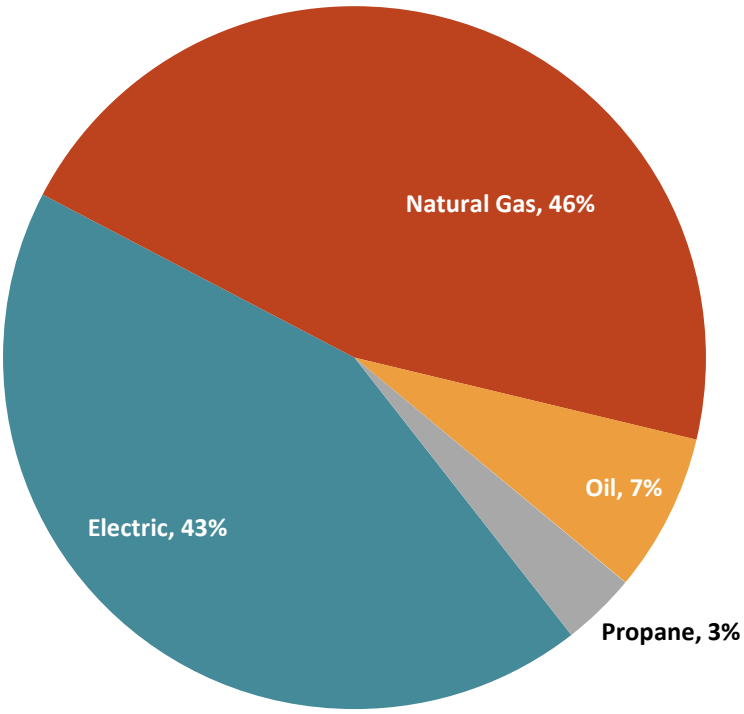


Table 4-59: Water Heating Fuel Type by Statewide Weights

Fuel Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Electric	42%	36%	46%	81%	43%
Natural Gas	43%	59%	52%	6%	46%
Oil	10%	5%	1%	8%	7%
Propane	5%	0%	1%	6%	3%
Other	0%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

Shared Water Heating Systems. Shared water heating systems were found in 36% of multifamily units. Statewide, shared water heating systems were found in 7% of the surveyed homes. No water heating systems were found in 2 homes.

Table 4-60: Shared Water Heating Systems by Statewide Weights

Shared?	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
No	100%	100%	64%	100%	93%
Yes	0%	0%	36%	0%	7%
None	0%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

Water Heating System Type. Of electric water heaters, the large majority (99%) are traditional storage tank water heaters. Approximately 1% of electric water heaters are considered heat pump water heater. The remaining electric water heaters were small on-demand systems. Note that the number of observations shown below is limited only to those surveyed residences with electric water heating.

Table 4-61: Electric Water Heating System Type by Statewide Weights

System Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Heat Pump WH	1%	0%	0%	0%	1%
Stand Alone Tank	99%	100%	100%	93%	99%
On Demand	0%	0%	0%	7%	1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	131	29	34	22	216

Water Heating Age. Statewide, the average age of electric water heater surveyed statewide is 8 years. The number of observations is limited only to those surveyed residences with electric water heating.

Table 4-62: Water Heater Age by Statewide Weights

Avg. Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Years	8	9	8	7	8
n	124	27	25	19	195

The table below presents the age range of electric water heating systems surveyed statewide. Overall, 40% of installed systems are more than 10 years old, while roughly one-third are estimated to be 3 years old or less.

Table 4-63: Water Heater Age Range by Statewide Weights

Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	40%	20%	25%	39%	35%
5-9 Years	22%	31%	27%	41%	25%
10-14 Years	18%	29%	40%	13%	23%
15-19 Years	11%	16%	3%	5%	10%
20 Years or Older	8%	4%	5%	1%	7%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	124	27	25	19	195

Tank Temperature. Water heater tank temperature was determined either by the tank temperature set point (when available), or the temperature of hot water from the nearest faucet to the storage tank. The average electric water heater tank temperature set point statewide was estimated to be 119°F. The number of observations is limited only to those surveyed residences with electric water heating.

Table 4-64: Water Heater Tank Temperature by Statewide Weights

Avg.Temp	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Degrees F	119	121	121	115	119
n	126	27	33	21	207

Tank Capacity. The average electric water heater tank capacity statewide was found to be 48 gallons. The number of observations is limited only to those surveyed residences with electric water heating.

Table 4-65: Water Heater Tank Capacity by Statewide Weights

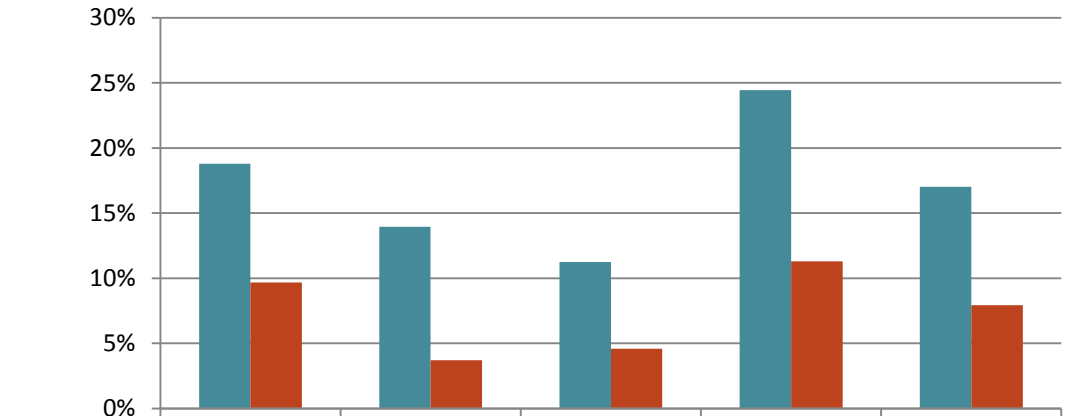
Avg. Tank Size	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Gallons	51	47	40	39	48
n	131	29	28	20	208

4.6.2 Water Heater Accessories

Pipe Wrap. 17% of water heaters surveyed were found to have pipe wrap located on pipes near the water heater.

Water Heater Blanket. Tank wrap was found on less than 8% of electric water heating units surveyed.

Figure 4-18: Water Heater Blanket & Pipe Wrap by Statewide Weights



	SF-Detached	SF-Attached	Multi	Manuf.	Statewide
Pipe Wrap	19%	14%	11%	24%	17%
Tank Wrap	10%	4%	5%	11%	8%

	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n (Pipe Wrap)	294	75	59	19	447
n (Tank Wrap)	296	75	55	19	445

4.6.3 Other

Water efficiency measures aid in energy conservation by reducing hot water usage, and subsequently reducing the overall energy needed to heat water. The most typical water heating efficiency measures are low-flow showerheads and faucet aerators.

Faucet Aerators. Statewide, homes have an average of 3.5 sinks. As indicated by the saturations, homes average 1.2 faucet aerators. Overall 35% of all sinks in the surveyed homes were equipped with low flow faucet aerators.

Table 4-66: Sinks and Faucet Aerators by Statewide Weights

Faucet Aerators	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Avg. # of Faucets	4.0	3.3	2.4	2.7	3.5
Avg. # Low Flow	1.3	1.2	1.1	1.0	1.2
% Low Flow	32%	35%	46%	37%	35%
n	296	78	89	27	490

Showerheads. On average, homes have 1.2 showerheads per home statewide. Low flow showerheads (< 2.0 gallon/minute) were found on 45% of all showerheads.

Table 4-67: Showers and Low Flow Showerheads by Statewide Weights

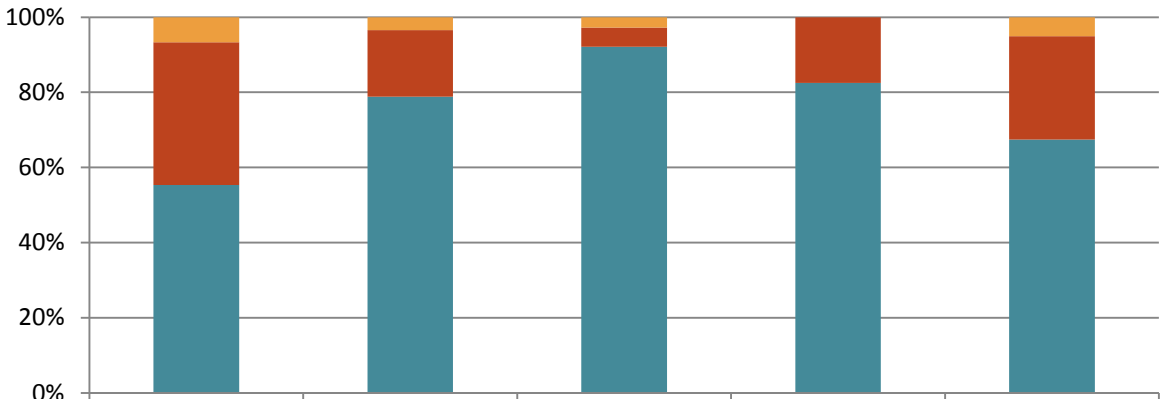
Showerheads	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Avg. # of Showerheads	1.3	1.2	1.1	1.0	1.2
Avg. # Low Flow	0.6	0.5	0.5	0.2	0.5
% Low Flow	46%	46%	44%	20%	45%
n	296	78	89	27	490

4.7 OTHER APPLIANCES

4.7.1 Refrigerators/Freezers

Number of Refrigerators. Statewide, every surveyed home had at least one refrigerator. Most surveyed homes (67%) have only one refrigerator, while 32% had at least two refrigerators. SF-Detached houses had the highest percent of two or more refrigerators relative to other housing types. Multifamily units were most likely to only have one refrigerator.

Figure 4-19: Number of Refrigerators by Statewide Weights



	SF-Detached	SF-Attached	Multi	Manuf.	Grand Total
3+	7%	3%	3%	0%	5%
2	38%	18%	5%	18%	27%
1	55%	79%	92%	82%	67%

	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	296	78	89	27	490

Refrigerator Type. The most common type of refrigerator is the top-mount freezer across all housing types, followed by side-by-side models, and bottom-mounted freezers. Compact refrigerators consist of 11% of all refrigerators found in homes.

Table 4-68: Refrigerator Type by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Bottom Freezer	17%	7%	3%	5%	13%
Compact	11%	15%	5%	5%	11%
Side by Side	28%	27%	4%	31%	24%
Top Freezer	44%	51%	89%	60%	52%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	445	99	98	30	672

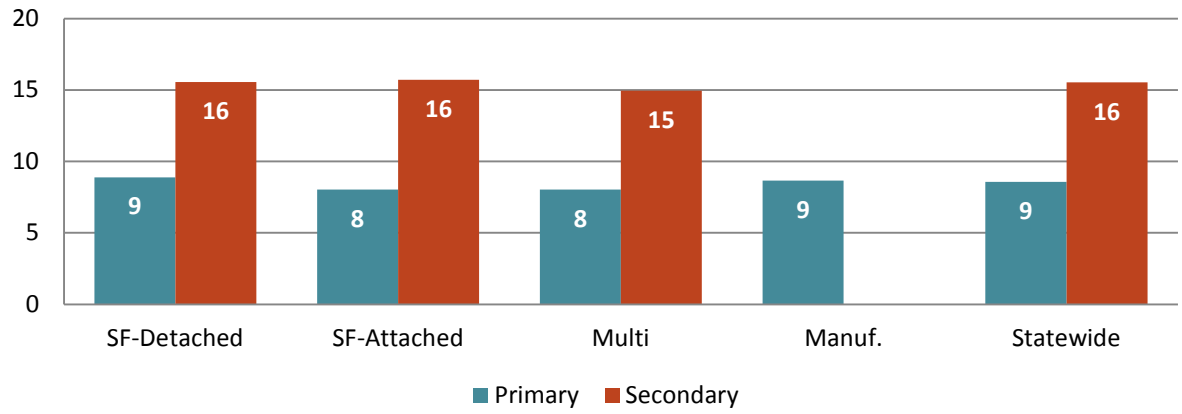
Refrigerator Size. The average refrigerator volume, excluding compact refrigerators is approximately 20.3 cubic feet.

Table 4-69: Average Refrigerator Size by Statewide Weights

Avg. Volume	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Cubic feet	21.0	20.8	17.6	18.2	20.3
n	380	86	93	27	586

Refrigerator Age. The average primary refrigerator was approximately 9 years old. Second refrigerators were, on average, older than primary units (16 years old).

Figure 4-20: Average Refrigerator Age by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n (Primary)	283	72	75	24	454
n (Secondary)	87	10	6	0	103

The table below provides the age distribution of primary refrigerators across the state by housing type.

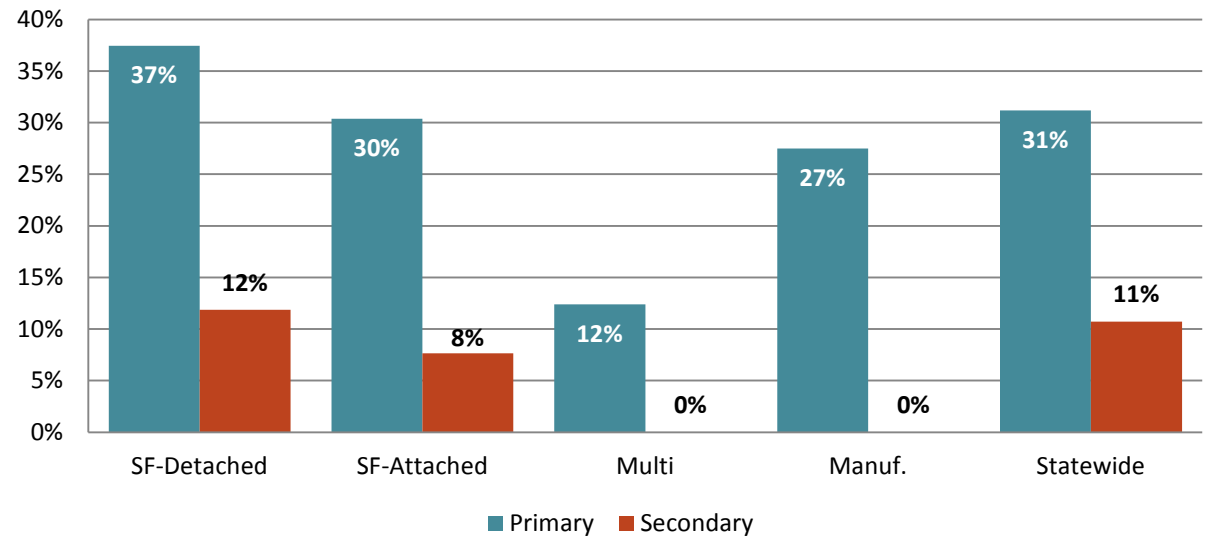
Table 4-70: Distribution of Primary Refrigerator Age by Statewide Weights

Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	33%	31%	31%	35%	32%
5-9 Years	30%	33%	32%	33%	31%
10-14 Years	20%	25%	23%	16%	21%
15-19 Years	7%	5%	7%	11%	7%
20 Years or Older	10%	6%	7%	6%	9%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	283	72	75	24	454

ENERGY STAR Refrigerators. On average, 31% of all primary refrigerators currently possess the ENERGY STAR logo or are qualified as ENERGY STAR compliant. Multifamily units had the lowest percent of ENERGY STAR rated primary refrigerators (12%). Secondary refrigerators were much less likely to be ENERGY STAR rated. Only 11% of secondary refrigerators were considered ENERGY STAR.

Where possible, the SWE team collected make/model information of refrigerators and verified ENERGY STAR status.

Figure 4-21: ENERGY STAR Refrigerators by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n (Primary)	283	72	75	24	454
n (Secondary)	87	10	6	0	103

Refrigerator Removal. During the on-site assessments, homeowners were asked if they had removed a refrigerator (primary or secondary) from their home over the last five years. If a refrigerator had been removed, homeowners were asked about the removal process. The majority of removed refrigerators

were picked up by retailers followed by utility recycling. Statewide, less than 10% of homes that removed a refrigerator over the last 5 years either donated, sold, or trashed their refrigerators.

Table 4-71: Refrigerator Removal Process by Statewide Weights

Refrig. Removal	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Donated	10%	5%	4%	12%	9%
I sold it	5%	3%	0%	0%	4%
Picked up by retailer	43%	65%	42%	35%	46%
Recycled by utility	28%	20%	9%	40%	25%
Trash	10%	5%	13%	12%	9%
Other	4%	2%	33%	0%	7%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
N	100	16	16	7	139

The majority of homes (96%) that removed a refrigerator over the last 5 years indicated that they replaced the removed refrigerator. The survey did not distinguish whether the removed refrigerator was the household's primary or secondary unit.

Table 4-72: Refrigerator Removal & Replacement by Statewide Weights

Refrig. Replaced	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
No	7%	0%	0%	0%	4%
Yes	93%	100%	100%	100%	96%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
N	103	16	16	7	142

Number of Freezers. 61% of houses statewide do not possess a stand-alone freezer. Additionally, homes with freezers are unlikely to have multiple units. Generally only 3% of homes have two or more stand-alone freezers. No SF-Attached, multifamily, or manufactured homes had more than one stand-alone freezer present.

Table 4-73: Number of Stand-Alone Freezers by Statewide Weights

#	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0	49%	74%	90%	54%	61%
1	46%	26%	10%	46%	36%
2	3%	0%	0%	0%	2%
3+	1%	0%	0%	0%	1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
N	296	78	89	27	490

Freezer Type. Statewide, there is near even distribution of upright vs. chest freezers in surveyed households. Overall roughly half of freezers were upright models and half were chest freezers.

Table 4-74: Stand-Alone Freezer Type by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Upright	48%	58%	44%	62%	49%
Chest	52%	42%	56%	38%	51%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	166	19	9	13	207

Freezer Age. The statewide average age of stand-alone freezers was 12 years old. As not all homes are equipped with stand-alone freezers, the sample size is limited outside of the SF-Detached data.

Table 4-75: Stand-Alone Freezer Age by EDC by Statewide Weights

Avg. Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Years	13	8	11	8	12
n	155	17	8	11	191

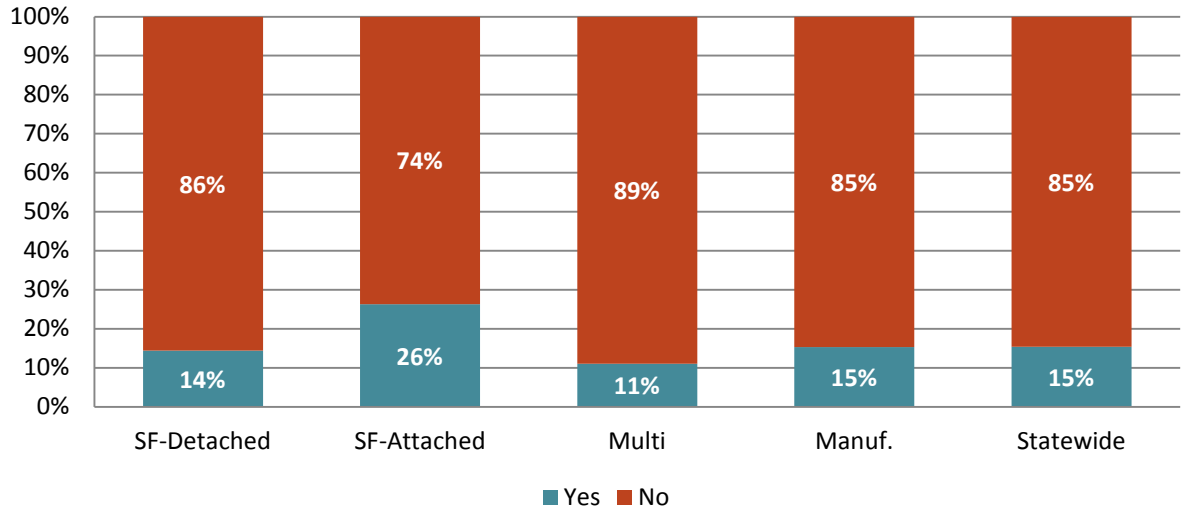
Table 4-76: Distribution of Freezer Age by Statewide Weights

Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	27%	35%	50%	36%	29%
5-9 Years	23%	29%	0%	18%	22%
10-14 Years	15%	24%	13%	27%	16%
15-19 Years	10%	0%	13%	9%	9%
20 Years or Older	25%	12%	25%	9%	23%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	155	17	8	11	191

ENERGY STAR Freezers. Only 15% of stand-alone freezers statewide were considered to be ENERGY STAR compliant. 14% of freezers in SF-Detached houses were ENERGY STAR. Sample sizes in other housing types are outside of the 90/10 confidence interval.

Where possible, the SWE team collected make/model information of freezers and verified ENERGY STAR status.

Figure 4-22: ENERGY STAR Stand-Alone Freezers by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	166	19	9	13	207

4.7.2 Clothes Washers/Dryers

Number of Clothes Washers. The statewide penetration of "in the home" clothes washers is 90% for all housing types combined. 99% of SF-Detached houses have at least one clothes washer (101% saturation). These figures do not include shared clothes washing units commonly found in central facilities in multifamily housing units.

Table 4-77: Number of Clothes Washers by Statewide Weights

Clothes Washer	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Penetration	99%	87%	47%	99%	90%
Saturation	101%	87%	49%	99%	92%
n	296	78	89	27	490

Clothes Washer Type. The majority of clothes washers surveyed statewide were top-loading (72%), as opposed to horizontal-axis machines (28%).

Table 4-78: Top-Loading vs. Front-Loading Clothes Washers by Statewide Weights

Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Horizontal Axis	29%	25%	29%	27%	28%
Vertical Axis	71%	75%	71%	73%	72%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	294	69	33	26	422

Clothes Washer/Water Heating Type. The majority of clothes washers are supplied with either electric or natural gas water heating (44% each).

Table 4-79: Clothes Washer/Water Heating Fuel Type by Statewide Weights

WH Fuel Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Electric	43%	37%	46%	81%	44%
Natural Gas	42%	57%	51%	6%	44%
Oil	9%	6%	2%	8%	8%
Propane	5%	0%	0%	6%	3%
Other	1%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	294	69	33	26	422

Clothes Washer Age. The average clothes washer age, based on "in the home" clothes washers in all housing types, is approximately 8 years old.

Table 4-80: Clothes Washer Age by Statewide Weights

Avg. Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Years	8	9	11	8	8
n	266	56	25	25	372

Table 4-81: Age Distribution of Clothes Washers by Statewide Weights

Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	34%	20%	27%	29%	31%
5-9 Years	33%	43%	23%	38%	34%
10-14 Years	16%	16%	22%	17%	16%
15-19 Years	10%	17%	1%	10%	11%
20 Years or Older	7%	3%	27%	7%	8%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	266	56	25	25	372

Loads per Week. According to homeowner usage estimates, the average household with a private washer runs 5 loads of laundry per week. The number of loads is fairly consistent across all housing types despite a limited number of observations in select housing types.

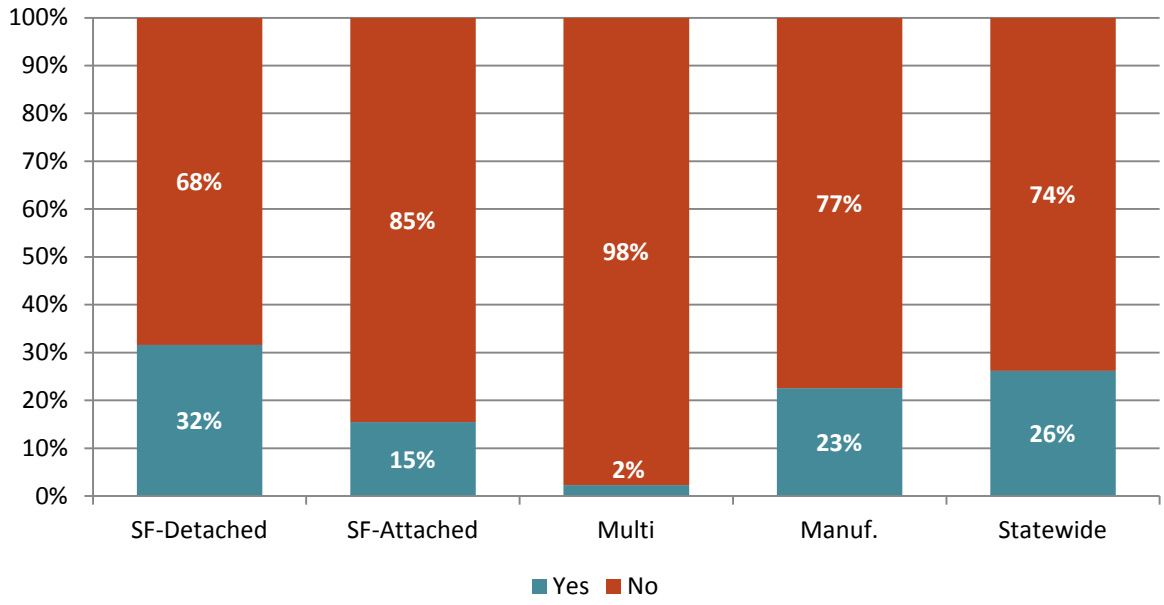
Table 4-82: Clothes Washer Loads per Week by Statewide Weights

Avg. Use	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Loads/Week	5	4	4	4	5
n	293	65	33	26	417

ENERGY STAR Clothes Washers. 26% of private clothes washers, statewide, were ENERGY STAR rated based on the statewide weighting.

The SWE team documentation of ENERGY STAR clothes washers was based on the ability to visually detect the label or determine that a particular model was ENERGY STAR rated by searching for the make and model number on the ENERGY STAR website or manufacturer data. It should be noted that there are likely occasions where a clothes washer was ENERGY STAR compliant at one time, but may have since lost its rating due to increased efficiency standards.

Figure 4-23: ENERGY STAR Clothes Washer by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	294	69	33	26	422

Dryer Fuel Type. Electric dryers are more prevalent on average than natural gas dryers across all housing types statewide. Overall, 76% of all dryers use electricity. Comparatively, only 23% use natural gas. As expected, dryers that use bottle fuels are rare.

Table 4-83: Dryer Fuel Type by Statewide Weights

WH Fuel Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Electric	73%	75%	82%	94%	76%
Natural Gas	24%	25%	18%	6%	23%
Propane	3%	0%	0%	0%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	284	68	48	26	426

The table below provides even further disaggregation to show the clothes washer water heater fuel type and dryer fuel type combination. In general, homes with clothes washers and electric water heating are unlikely to have non-electric dryers. The likelihood of non-electric dryers increases when the clothes washer is equipped with non-electric water heating.

Table 4-84: Clothes Washer Water Heater / Dryer Fuel Type Combo by Statewide Weights

Fuel Type Combo	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Clothes Washers with Electric WH & Dryer Fuel Type Combo					
Electric	38%	34%	41%	78%	40%
Non-Electric	4%	1%	0%	3%	3%
No Dryer	1%	1%	5%	0%	1%
Clothes Washers with Non-Electric WH & Dryer Fuel Type Combo					
Electric	33%	38%	43%	16%	34%
Non-Electric	22%	24%	8%	3%	20%
No Dryer	2%	1%	3%	0%	2%
n	294	69	33	26	422

4.7.3 Dishwashers

Number of Dishwashers. 67% of homes surveyed have a dishwasher, with dishwashers being most common in SF-Detached housing units (79%).

Table 4-85: Dishwasher Penetration by Statewide Weights

Dishwasher	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Penetration	79%	63%	34%	61%	67%
n	296	78	89	27	490

Dishwasher/Water Heating Type. The percent of dishwashers with electric water heating is 43% of all dishwashers. The majority of the hot water supplied to dishwashers is heated by natural gas (49%).

Table 4-86: Dishwasher/Water Heating Type by Statewide Weights

WH Fuel Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Electric	39%	45%	37%	88%	43%
Natural Gas	49%	53%	63%	6%	49%
Oil	8%	2%	0%	0%	5%
Propane	4%	0%	0%	6%	3%
Other	0%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	**225**	**55**	**30**	**17**	**327**

Dishwasher Age. The statewide average age of a dishwasher is 9 years.

Table 4-87: Dishwasher Age by Statewide Weights

Avg. Age	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Years	9	8	11	8	9
n	209	49	21	16	295

Table 4-88: Age Distribution of Dishwashers by Statewide Weights

Age Range	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0-4 Years	25%	10%	29%	29%	28%
5-9 Years	38%	29%	41%	29%	31%
10-14 Years	31%	33%	14%	22%	22%
15-19 Years	6%	14%	6%	10%	9%
20 Years or Older	0%	14%	10%	10%	10%
Grand Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
n	209	49	21	16	295

Dishwasher Loads per Week. According to homeowner usage estimates, the statewide average is 3 dishwasher loads per week.

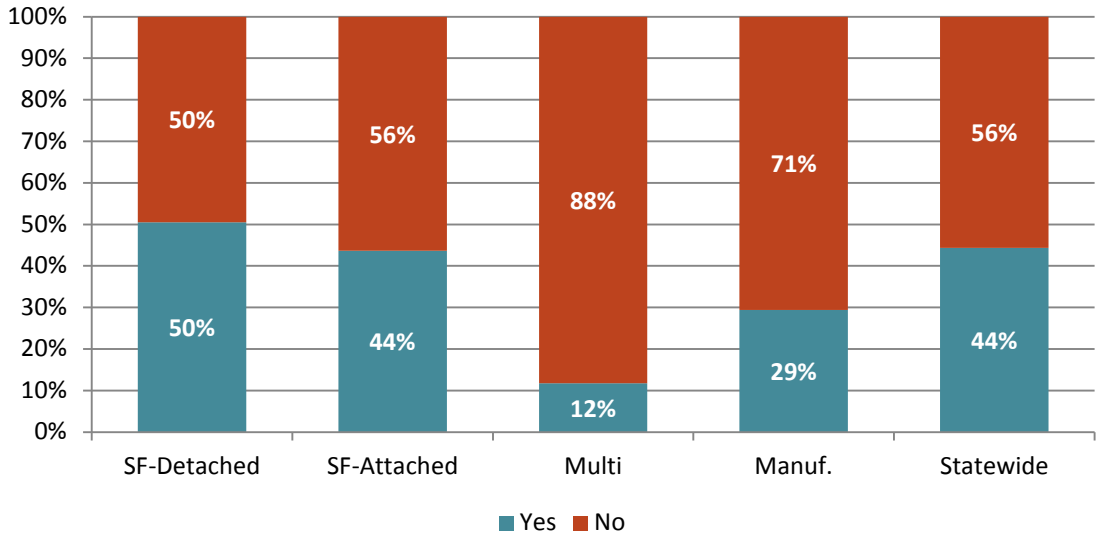
Table 4-89: Dishwasher Loads per Week by Statewide Weights

Avg. Use	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Loads/Week	3	2	2	3	3
n	224	55	34	17	330

ENERGY STAR Dishwashers. 44% of dishwashers were ENERGY STAR rated across the EDCs. Approximately 50% of SF-Detached houses had ENERGY STAR compliant dishwashers. Other housing types have limited observations that fall below a 90/10 level of confidence and precision.

Where possible, the SWE team collected make/model information of dishwashers and verified ENERGY STAR status.

Figure 4-24: ENERGY STAR Dishwashers by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	225	55	34	17	331

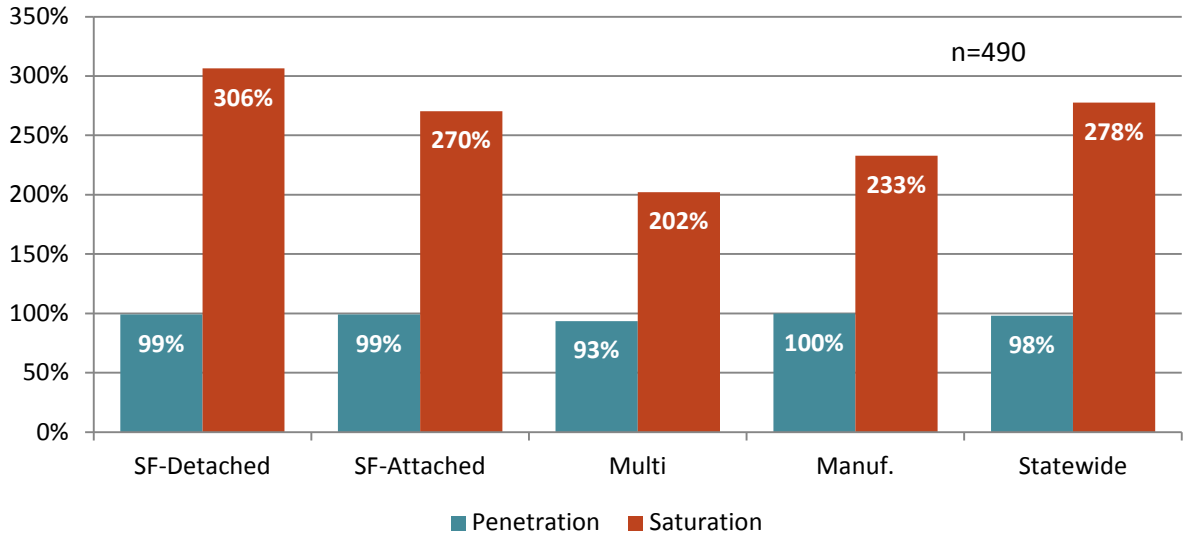
4.7.4 Consumer Electronics

Number of Televisions. Nearly every residence surveyed had at least one television. Statewide, the average household had nearly 2.8 televisions per household. SF-Detached averaged just over three televisions per household. Multifamily units averaged two televisions per household.

Table 4-90: Number of Televisions by Statewide Weights

# of TVs	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
0	1%	1%	7%	0%	2%
1	10%	21%	23%	17%	15%
2	32%	23%	44%	40%	33%
3	22%	30%	23%	34%	24%
4	17%	18%	2%	8%	14%
5+	17%	8%	2%	0%	12%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	296	78	89	27	490

Figure 4-25: Penetration/Saturation of Televisions by Statewide Weights



	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	296	78	89	27	490

Television Type/Size. Only 30% of all televisions statewide are currently estimated to have a screen-size of 40 inches or larger. However, 45% of all flat screen televisions (LED, LCD, and Plasma) are 40 inches or larger.

Table 4-91: Screen Size of Televisions by Statewide Weights

Screen Size	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
< 20"	19%	20%	23%	26%	20%
20"-29"	25%	22%	31%	32%	26%
30"-39"	25%	22%	22%	24%	24%
40"-49"	20%	23%	17%	10%	20%
50"-59"	8%	10%	7%	7%	8%
60" & up	2%	3%	0%	1%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	878	217	187	62	1344

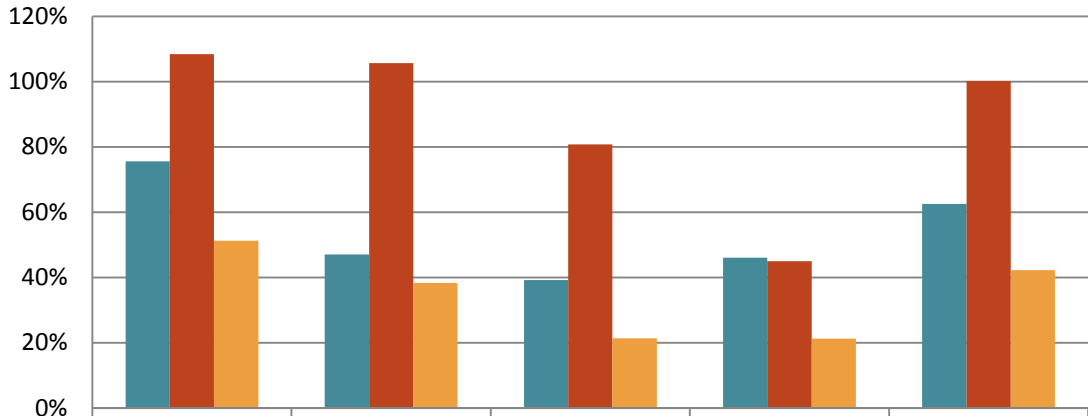
Table 4-92: Screen Size of Flat Screen Televisions by Statewide Weights

Screen Size	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
< 20"	13%	8%	13%	12%	12%
20"-29"	13%	8%	14%	11%	12%
30"-39"	29%	33%	35%	38%	31%
40"-49"	31%	34%	29%	23%	31%

Screen Size	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
50"-59"	12%	13%	9%	14%	12%
60" & up	3%	4%	0%	3%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
n	**551**	**128**	**101**	**31**	**811**

Saturation of Desktops/Laptops/Tablets. Statewide, the saturation of Desktop, Laptop, and Tablet PCs is 63%, 100%, and 42% respectively. Saturations meet or exceed 100% for select housing types because some residences possess more than one computer type at a single residence. Presently, laptops are the most common type of computer across all housing types, with the exception of manufactured homes (Desktop, 46% vs. Laptop, 45%).

Figure 4-26: Saturation of Desktop, Laptop, and Tablet PCs by Statewide Weights



	SF-Detached	SF-Attached	Multi	Manuf.	Statewide
Desktop	76%	47%	39%	46%	63%
Laptops	108%	106%	81%	45%	100%
Tablets	51%	38%	21%	21%	42%

	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
n	296	78	89	27	490

PC Monitor Type. 10% of PC Monitors surveyed were equipped with CRT Monitors. The large majority of computers utilize LCD flat screen monitors.

Table 4-93: PC Monitor Type by Statewide Weights

PC Monitors	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
CRT	10%	6%	13%	6%	10%
Flat Screen	90%	94%	87%	94%	90%
n	177	36	30	11	254

Power strips. The percentage of television units and desktop/laptop PCs with power strip units is presented in the table below. The majority of televisions and PCs plug into power strips rather than directly into wall sockets. Only 3% of televisions and 3% of PC units were identified as plugged into advanced, energy-savings, power strips.

Table 4-94: Power Strip Type by Statewide Weights

Power Strips	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Television Units					
Basic Power Strip	52%	63%	59%	62%	55%
No Strip	45%	32%	39%	35%	41%
Smart Strip	3%	4%	2%	3%	3%
n	876	215	187	62	1340
Desktop/Laptop PC					
Basic Power Strip	56%	56%	58%	65%	56%
No Strip	40%	41%	41%	35%	40%
Smart Strip	4%	3%	1%	0%	3%
n	369	88	75	23	555

Additionally, of homes with power strips (Basic & Advanced Smart Strips), the average number of peripheral devices associated with television and PC units is two. These peripherals are in addition to the power source for the television and PC units.

Table 4-95: Average Number of Peripheral TV and Computer Devices by Statewide Weights

Avg. # of Peripherals	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Television Units					
Avg. Number	2.1	1.9	2.0	1.8	2.0
n	491	133	112	41	777
Desktop/Laptop PC					
Avg. Number	2.3	2.0	1.5	1.8	2.1
n	211	53	42	14	320

Miscellaneous Consumer Electronics. The statewide penetration and saturation of various small consumer electronics collected by the SWE team is presented below.

Of the surveyed equipment, fax machines and home theater systems are the least common items in the surveyed households. The saturation of gaming systems is roughly 61% statewide. On average, homes have an average of more than one DVD player, and two mobile phone chargers.

Table 4-96: Penetration/Saturation of Miscellaneous Electronics by Statewide Weights

Misc. Electronics	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
DVD					
Penetration	86%	92%	75%	79%	85%
Saturation	126%	127%	92%	91%	118%
Fax Machine					
Penetration	38%	38%	12%	17%	32%
Saturation	44%	43%	13%	17%	37%
Gaming					
Penetration	40%	48%	34%	38%	41%
Saturation	62%	67%	55%	45%	61%
Home Theater					
Penetration	26%	23%	14%	21%	23%
Saturation	28%	24%	14%	22%	25%
Phone Charger					
Penetration	94%	92%	95%	83%	93%
Saturation	214%	181%	169%	137%	197%
Stereo					
Penetration	56%	44%	49%	37%	52%
Saturation	75%	60%	60%	46%	68%
VCR					
Penetration	48%	41%	29%	59%	44%
Saturation	58%	47%	39%	59%	52%
n	292	78	88	27	485

4.7.5 Other

Humidifiers. Humidifiers were present in only 11% of surveyed homes (14% of SF-Detached residences). Few homes had more than one humidifier with a total statewide saturation of 13% across all households.

Dehumidifiers. At least one dehumidifier was present in 36% of surveyed homes statewide and 52% of SF-Detached housing. After accounting for homes with multiple dehumidifiers, the saturation is estimated to be 43% statewide and 63% of SF-Detached residences).

Table 4-97: Humidifier/Dehumidifiers Saturation by Statewide Weights

	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Humidifiers					
Penetration	14%	10%	2%	28%	11%
Saturation	15%	12%	2%	33%	13%
n	296	78	89	27	490

	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Dehumidifiers					
Penetration	52%	22%	3%	18%	36%
Saturation	63%	22%	3%	18%	43%
n	296	78	89	27	490

Humidifiers/Dehumidifier Usage. On average, dehumidifiers run 7 months per year. Humidifiers run less, an average of 4 months per year. It is important to note that many of the surveyed households did not have humidifiers or dehumidifiers or did not provide a response to this usage question creating limited samples sizes across the housing unit types.

Table 4-98: Humidifier/Dehumidifier Use (Months/Year) by EDC

Avg. Use	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Humidifiers					
Months	5	2	4	4	4
n	41	6	2	4	53
Dehumidifiers					
Months	7	8	7	7	7
n	154	19	3	3	179

Ceiling Fans. More than three-quarters of homes have at least one ceiling fan at the statewide level. The penetration of ceiling fans is even greater for SF-Detached housing, at 85% of the surveyed homes. The average number of ceiling fans in all homes was 2.2 across all housing types, and 2.7 for SF-Detached houses.

Oscillating Fans. In addition to ceiling fans, 68% of homes have at least one oscillating fan and an average of 1.3 per home. Oscillating fans were most common in SF-Detached and multifamily units.

Table 4-99: Penetration/Saturation of Ceiling Fans by EDC

	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Ceiling Fans					
Penetration	85%	76%	43%	86%	76%
Saturation	273%	188%	93%	171%	220%
n	296	78	89	27	490
Oscillating Fans					
Penetration	70%	64%	70%	46%	68%
Saturation	143%	111%	122%	94%	131%
n	296	78	89	27	490

Ceiling Fan Usage. Based on homeowner responses, approximately 31% of all ceiling fans and 36% of all oscillating fans are used 6 hours per day or more during the cooling season.

Table 4-100: Ceiling Fan Hours of Use by EDC

6+ Hrs/Day	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Ceiling Fans					
Yes	29%	35%	45%	34%	31%
n	252	57	43	23	375
Oscillating Fans					
Yes	30%	53%	44%	37%	36%
n	206	47	59	14	326

Pools & Hot Tubs. The vast majority of homes, statewide, do not have any outdoor recreational equipment such as a swimming pool or hot tubs. 94% of households or more have no private swimming pools. Private pools are generally only found in a small number of SF-Detached houses. Similarly, 95% of homes surveyed do not have a hot tub or spa.

Table 4-101: Pool/Spa Saturation by EDC

Pool Type	SF-Detached	SF-Attached	Multifamily	Manufactured	Statewide
Above Ground	5%	1%	0%	0%	3%
In Ground	5%	0%	0%	0%	3%
Hot Tub/Spa	7%	1%	2%	0%	5%
n	296	78	89	27	490

4.8 COMPARISON OF RESULTS BETWEEN GROUPS

This section describes the residential sector findings obtained from statistical significance testing conducted on select variables to determine whether any significant differences regarding the installation of energy efficient lighting, appliances, and efficient building shell characteristics exist between various groups. Groups examined include owners vs. renters, non-retired vs. retirement-age customers, and low income vs. non-low income consumers. The appliances analyzed within this section include refrigerators, freezers, clothes washers, dishwashers, and room air conditioners. The building shell characteristics analyzed included attic and wall insulation R-value levels and the proportion of high efficiency windows (double-pane low-e or triple-pane) relative to all windows Significance tests were also performed to determine whether the proportion of energy efficient equipment has changed since the 2012 Residential Baseline Study. The primary statistical tests utilized were the chi-square test and the difference of means test (t-test). All tests were executed at the 0.05 significance level. Results are presented at the statewide level across all housing types.

4.8.1 Owners vs Renters

In terms of the proportion of customers who own energy efficient appliances, there appears to be a significant difference between owners and renters. Moreover, a much greater percentage of owners have energy efficient appliances than do renters. The results of all own vs. renter statistical tests are presented in Table 4-102 below.

Table 4-102: Energy Efficient Appliance Ownership by Owner vs. Renter

Variable	Own	Rent	Result
Lighting			
Lighting (Saturation of CFL/LED Sockets - %)	26%	33%	Significant
Lighting (Avg. CFL/LED bulbs per home – All homes)	14.2	6.0	Significant
Lighting (Avg. CFL/LED bulbs per home – Homes with at least 1 CFL/LED)	15.4	7.4	Significant
Appliances			
Refrigerator (Energy Star - %)	28%	10%	Significant
Freezer (Energy Star - %)	20%	6%	Insignificant
Clothes Washer (Energy Star - %)	26%	13%	Significant
Dishwasher (Energy Star - %)	47%	24%	Significant
Room AC (Energy Star - %)	30%	14%	Significant
Shell			
Roof Insulation (Avg. R-value)	25.0	23.9	Insignificant
Wall Insulation (Avg. R-value)	13.0	12.4	Insignificant
Windows (Energy Efficient - %)	29%	5%	Significant

As Table 4-102 above illustrates, all tests exhibited statistical significance at the 0.05 level except for tests involving freezers and insulation R-value. The insignificant freezer result can be mainly attributed to the small sample size of freezers relative to the other appliances.

4.8.2 Age of Householder

No statistically significant difference in the ownership of energy efficient appliances was observed between residences where the age of the head of the household was under 65 versus 65 years of age or older. There was no statistically significant difference in insulation R-values between the two groups, while homeowners less than 65 years of age were more likely to have energy efficient windows.

In the case of lighting, although the average number of efficient bulbs per home proved to be similar for both age groups, a significantly greater overall percentage of sockets were occupied by efficient lighting in homes with a householder younger than 65. This is likely due to the finding that, on average, householders under the age of 65 live in homes with fewer sockets than do householders 65 or older. At the statewide level, residences where the head of household is under 65 years of age have approximately 13 fewer total sockets (47) compared to homes where the homeowner is 65 years old or greater (60). The results of all statistical tests examining the age of householder variable are presented in Table 4-103 below.

Table 4-103: Energy Efficient Appliance Ownership by Age of Householder

Variable	Less than 65	65 or older	Result
Lighting			
Lighting (Saturation of CFL/LED Sockets - %)	30%	21%	Significant
Lighting (Avg. CFL/LED bulbs per home – All homes)	12.3	11.7	Insignificant

Variable	Less than 65	65 or older	Result
Lighting (Avg. CFL/LED bulbs per home – Homes with at least 1 CFL/LED)	13.7	13.4	Insignificant
Appliances			
Refrigerator (Energy Star - %)	22%	26%	Insignificant
Freezer (Energy Star - %)	17%	22%	Insignificant
Clothes Washer (Energy Star - %)	25%	22%	Insignificant
Dishwasher (Energy Star - %)	46%	43%	Insignificant
Room AC (Energy Star - %)	26%	26%	Insignificant
Shell			
Roof Insulation (Avg. R-value)	25.3	24.7	Insignificant
Wall Insulation (Avg. R-value)	13.1	12.7	Insignificant
Windows (Energy Efficient - %)	29%	19%	Significant

4.8.3 Low-Income vs Non-Low-Income

An examination of the effect of income on energy efficient appliance ownership and building shell characteristics revealed a statistically significant difference between low-income and non-low-income customers existed only for room air conditioners and energy efficient windows. However a statistically significant difference was observed for both the saturation of efficient lighting and the average number of efficient bulbs. On average, low-income survey respondents had fewer efficient bulbs than their non-low-income counterparts, but the energy efficient bulbs that low-income customers did own, comprised a greater percentage of their total bulb count. In general, low income households have fewer total sockets than those homes identified as non-low income, resulting in a greater saturation of CFL bulbs (as a % of total sockets), but an overall lower average number of CFL bulbs per household. The results of all statistical tests examining income are provided in Table 4-104 below.

Table 4-104: Energy Efficient Appliance Ownership by Low-Income vs. Non-Low-Income

Variable	Low-Income	Non-Low-Income	Result
Lighting			
Lighting (Saturation of CFL/LED Sockets - %)	37%	26%	Significant
Lighting (Avg. CFL/LED bulbs per home – All homes)	6.5	13.4	Significant
Lighting (Avg. CFL/LED bulbs per home – Homes with at least 1 CFL/LED)	7.2	15.0	Significant
Appliances			
Refrigerator (Energy Star - %)	25%	23%	Insignificant
Freezer (Energy Star - %)	12%	19%	Insignificant
Clothes Washer (Energy Star - %)	15%	25%	Insignificant
Dishwasher (Energy Star - %)	31%	46%	Insignificant
Room AC (Energy Star - %)	14%	30%	Significant
Shell			
Roof Insulation (Avg. R-value)	25.1	24.9	Insignificant
Wall Insulation (Avg. R-value)	12.8	13.0	Insignificant
Windows (Energy Efficient - %)	2%	29%	Significant

4.8.4 2013 vs 2011

Finally, the SWE Team examined select data fields in order to observe any significant trends in the adoption of energy efficient measures from 2011 to 2013[23]. Although a greater number of 2013 survey respondents owned efficient appliances than did their 2011 counterparts, only efficient freezer ownership exhibited a statistically significant difference between the two datasets. Attic and exterior wall insulation R-values were not significantly different between the two datasets, however, the proportion of energy efficient windows was significantly higher in the 2013 sample.

With regard to lighting, a significant difference was observed between the 2013 and 2011 efficient bulb saturations and the average number of bulbs per home. However, when the number of bulbs for homes with at least 1 efficient bulb was calculated, the difference between 2011 and 2013 averages turned out to be insignificant at the 0.05 level.[24] The results of all vintage tests are displayed in the table below.

Table 4-105: Energy Efficient Appliance Ownership by Survey Year

Variable	2013	2011	Result
Lighting			
Lighting (Saturation of CFL/LED Sockets - %)	27%	21%	Significant
Lighting (Avg. CFL/LED bulbs per home – All homes)	12.1[25]	9.4	Significant
Lighting (Avg. CFL/LED bulbs per home in homes w/ at least 1 CFL/LED)	13.6	11.5	Insignificant
Appliances			
Refrigerator (Energy Star - %)	24%	20%	Insignificant
Freezer (Energy Star - %)	19%	7%	Significant
Clothes Washer (Energy Star - %)	24%	24%	Insignificant
Dishwasher (Energy Star - %)	45%	38%	Insignificant
Room AC (Energy Star - %)	26%	21%	Insignificant
Shell			
Roof Insulation (Avg. R-value)	24.9	24.1	Insignificant
Wall Insulation (Avg. R-value)	13.0	14.6	Insignificant
Windows (Energy Efficient - %)	26%	19%	Significant

[23] Data collection for the 2014 baseline report was performed in late 2013. Similarly, data for the 2012 baseline study was collected in late 2011.

[24] There was a significant difference observed at the 0.10 level.

[25] Based on the sales of CFLs in PY3 and PY4, the SWE calculated that the Avg. # of CFL/LED bulbs per home should have increased to 12.2 bulbs from 2011 to 2013 assuming a 100% installation rate.

5 EDC SPECIFIC FINDINGS

5.1 INTRODUCTION

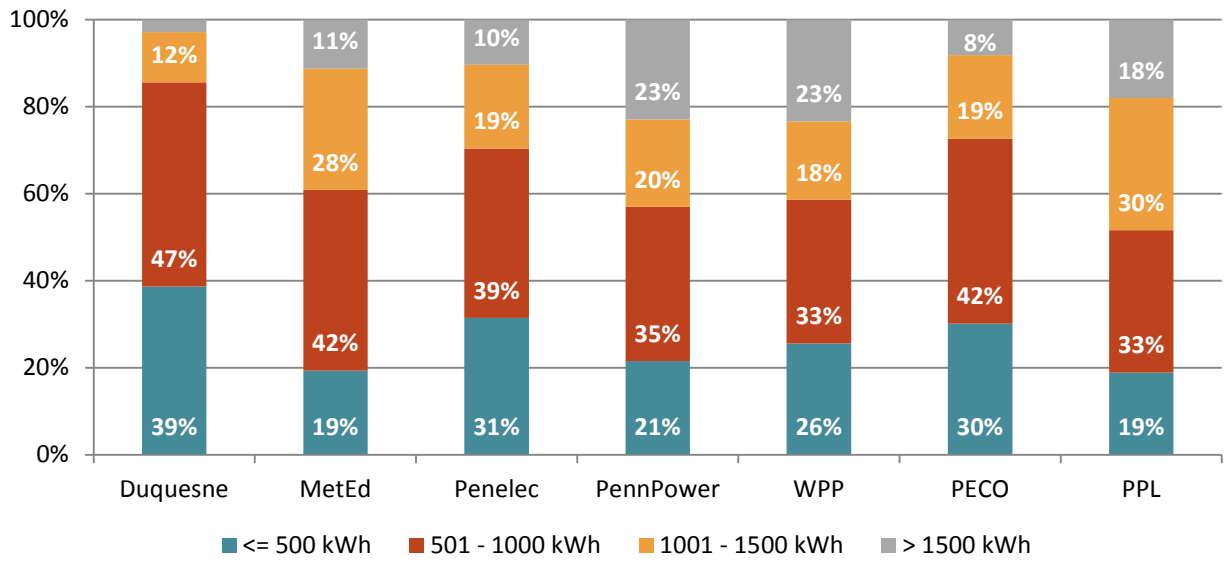
This section describes the residential sector findings obtained from the on-site survey collection and analysis activities for each of the seven EDCs located throughout Pennsylvania. As noted earlier in the report, EDC level results have been weighted based on housing type and age of head of household. See section 3.4.2 for more details.

5.2 BASIC HOME CHARACTERISTICS

5.2.1 Usage

The residential customers were stratified and recruited to attain a representative sample of each EDC territory in terms of average monthly usage and housing type. Figure 5-1 shows each EDCs representation of usage based on the final on-site sample's 2012 historical data usage. Results are based on the full sample of 70 homes per EDC.

Figure 5-1: Average Monthly Electricity Usage (based on 2012 historical data)



5.2.2 Home Type

Table 5-1 displays the types of residential sites surveyed after applying the EDC case weights. Single family detached houses are the dominant housing type across all EDCs. Single family attached houses consist of row houses, townhomes, and duplexes.

Table 5-1: Home Type by EDC

Home Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	63%	62%	71%	72%	70%	38%	70%
SF-Attached	10%	18%	4%	5%	6%	35%	15%
Multifamily	26%	16%	16%	16%	17%	26%	9%
Manuf./Mobile	1%	4%	9%	7%	7%	1%	5%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

Home Age. The average age of surveyed homes ranged from 45 years in the PPL and Penn Power territories to 66 years in the Penelec territory. Table 5-2 displays the distribution of the years of construction across the seven EDCs.

Figure 5-2: Average Age of Home by EDC

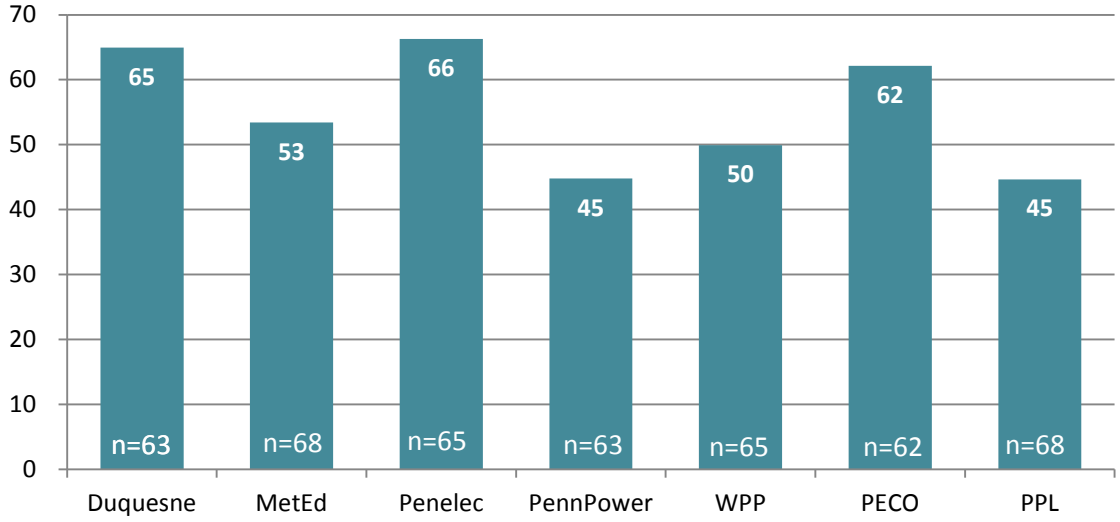


Table 5-2: Year of Construction by EDC

Year of Construction	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Pre 1920	13%	14%	31%	10%	14%	23%	12%
1920-1929	15%	7%	4%	5%	3%	3%	2%
1930-1939	8%	0%	5%	2%	9%	9%	3%
1940-1949	11%	5%	2%	2%	10%	2%	3%
1950-1959	26%	12%	10%	12%	5%	18%	16%
1960-1969	2%	3%	9%	12%	8%	9%	0%
1970-1979	6%	20%	15%	10%	9%	4%	20%
1980-1989	8%	10%	6%	12%	5%	13%	14%
1990-1999	6%	11%	7%	17%	16%	10%	5%
2000-2009	4%	18%	10%	16%	15%	9%	22%
2010 - Present	2%	0%	0%	3%	7%	0%	3%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	63	68	65	63	65	62	68

5.2.3 Home Size & Foundation

The average above ground square footage of conditioned space ranged from 1,494 sq. ft. in the Duquesne territory to 1,842 sq. ft. in the Penn Power area. Table 5-3 also provides the un-weighted average per home type, broken out by EDC, as well. The total average conditioned square footage (including conditioned basements) can be found in Table 5-4.

Table 5-3: Average Home Square Footage (Conditioned Space) by EDC

Home Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	1,774	2,114	2,002	2,057	1,863	2,230	1,906
SF-Attached	1,345	1,598	1,360	1,588	1,416	1,447	1,713
Multifamily	848	1,032	810	1,294	1,023	834	1,229
Manufactured	1,000	940	1,261	988	1,083	1,000	1,165
All Homes	**1,494**	**1,813**	**1,718**	**1,842**	**1,641**	**1,582**	**1,774**
n	69	69	70	68	69	70	69

Table 5-4: Average Home Square Footage (Conditioned Space) by EDC

Home Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
SF-Detached	2,249	2,517	2,516	2,426	2,498	2,663	2,225
SF-Attached	1,606	1,844	1,914	1,819	1,892	1,759	1,753
Multifamily	866	1,254	810	1,294	1,092	834	1,229
Manufactured	1,000	940	1,261	988	1,083	2,000	1,165
All Homes	**1,830**	**2,144**	**2,103**	**2,123**	**2,126**	**1,866**	**2,003**
n	69	69	70	68	69	70	69

Home Foundation. Across all EDCs, the majority of homes are equipped with conditioned or unconditioned basements. Slab and crawlspace foundations were generally found in 20% or less of all homes across all EDCs. Table 5-6, below, provides the breakout of conditioned vs. unconditioned basements across the seven EDCs.

Table 5-5: Foundation Type by EDC

Foundation	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Slab	11%	9%	6%	9%	6%	10%	7%
Crawlspace	1%	11%	10%	12%	7%	0%	11%
Basement	61%	50%	68%	54%	72%	73%	65%
Mix	9%	22%	9%	17%	6%	6%	15%
Over Apt. Unit	18%	8%	7%	8%	9%	12%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

Table 5-6: Basement Type by EDC

Basement Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Cond. /Uncond. Mix	4%	10%	5%	9%	7%	5%	5%
Cond. Basement	38%	15%	36%	21%	46%	27%	13%
Uncond. Basement	19%	24%	27%	25%	19%	41%	47%
No Basement	39%	50%	32%	46%	28%	27%	35%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

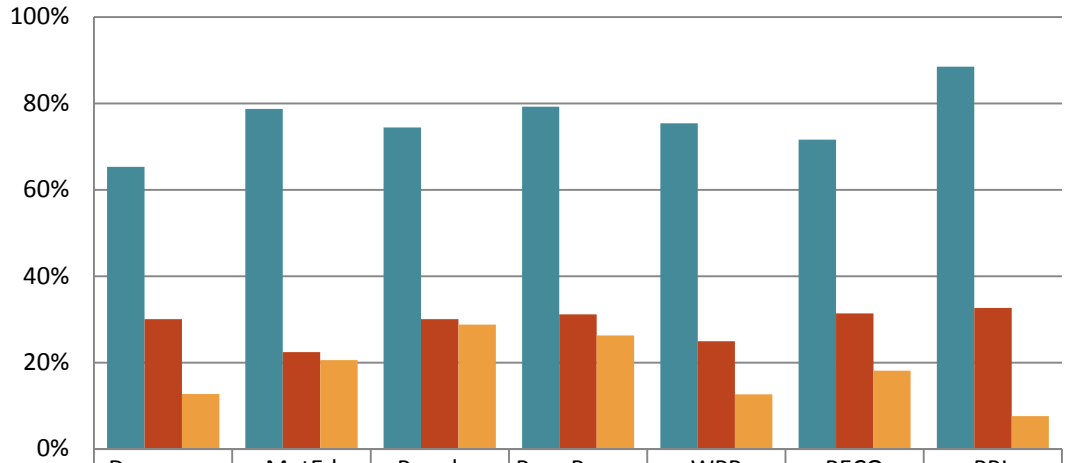
5.2.4 Demographics

Homeownership. Owner occupied housing units range from 65% in the Duquesne area to 88% in the PPL area. By contrast, Duquesne had the highest proportion of multifamily units whereas PPL had the lowest proportion of multifamily units.

Age of Head of Household. Homeowners were asked to indicate the age of the head of household. The proportion of homeowners 65 years or above ranged from 22% of all respondents in the Met-Ed territory to 33% of respondents in the PPL territory.

Income. The proportion of low income respondents ranged from 8% in the PPL service area to 29% in the Penelec service area. As noted earlier in this report, the SWE surveyors did not ask homeowners to provide their household income levels during the on-site assessment due to the sensitive nature of the topic. Instead, low-income status was identified via EDC records.

Figure 5-3: Select Demographics by EDC



	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
Own	65%	79%	74%	79%	75%	72%	88%
> 65 years old	30%	22%	30%	31%	25%	31%	33%
Low Income	13%	21%	29%	26%	13%	18%	8%

Note: All three demographic variables are based on the full dataset of 70 responses per EDC.

Type of Residence. Nearly all of surveyed homes (94-100% across the seven EDCs) are year-round, primary residences.

Table 5-7: Year Round Residences by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Year-Round	99%	99%	97%	99%	98%	98%	97%
n	70	70	70	70	70	70	70

Occupancy. The average year-round home occupancy ranges from 2.1 people to 2.5 across each EDC.

Table 5-8: Number of Year Round Occupants by EDC

Occupants	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Avg. # of Occupants	2.1	2.5	2.4	2.3	2.4	2.4	2.4
Max. # of Occupants	6	7	6	7	6	9	7
Min. # of Occupants	1	1	1	1	1	1	1
n	70	70	70	70	70	70	70

5.3 BUILDING SHELL

This section presents information on the characteristics of the building envelope found present at the surveyed residential homes throughout Pennsylvania.

5.3.1 Insulation

Attic Insulation. The majority of surveyed homes had some level of attic insulation present. Typically, less than 15% of homes were verified to have no attic insulation present. Surveyors were unable to verify the presence or absence of insulation in 14% to 41% of homes based on homes with limited or no access to attic space (particularly multifamily units).

Table 5-9: Presence of Attic Insulation by EDC

Insulation Present?	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Yes	60%	72%	58%	80%	70%	41%	81%
No	9%	12%	15%	4%	7%	14%	1%
No Attic	6%	2%	3%	2%	2%	4%	0%
Unknown	25%	15%	24%	14%	20%	41%	18%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

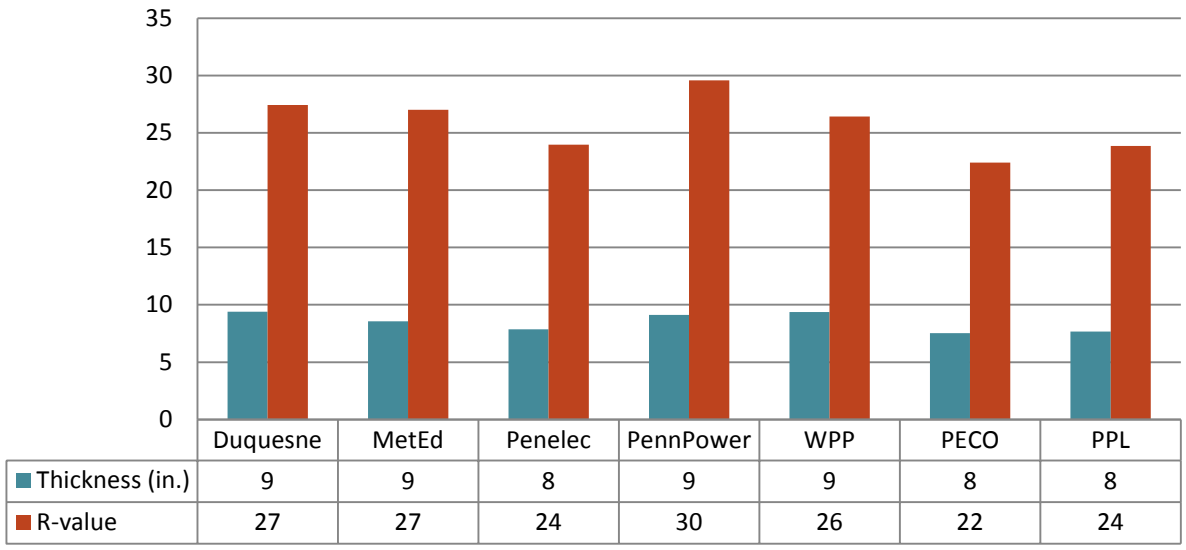
Attic Insulation Type. Where insulation was present, fiberglass is the predominant form of attic insulation. Fiberglass batting or loose-fill fiberglass was present in 59% to 87% of surveyed attics with insulation. Other includes rock wool, vermiculate, spray foam, as well as a mixture of fiberglass and other types. Note that not all attics were able to be inspected and verified to possess attic insulation.

Table 5-10: Type of Attic Insulation by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Cellulose Loose	19%	17%	6%	22%	11%	14%	15%
Fiberglass Batt	47%	49%	63%	50%	57%	39%	47%
Fiberglass Loose Fill	23%	20%	24%	9%	30%	36%	23%
Other	0%	8%	0%	7%	0%	4%	4%
Unknown	12%	6%	7%	11%	2%	8%	11%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	43	51	40	57	48	28	55

Attic Insulation Thickness. The average thickness of attic insulation, in homes with attic insulation present, ranged from 8 inches to 9 inches. The average insulation R-value, after accounting for insulation thickness and type, ranged from R22 (PECO) to R30 (PennPower). Due to limited access to attics, particularly in multifamily units, attic insulation thickness was not determined in all instances where attic insulation was present.

Figure 5-4: Attic Insulation Thickness/R-value by EDC



	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
Thickness (in.)	9	9	8	9	9	8	8
R-value	27	27	24	30	26	22	24

n	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n (Thickness)	34	43	35	48	41	26	36
n (R-value)	33	44	35	48	41	21	36

For homes with attic insulation, the table below indicates the proportion of insulation by R-value. In general, the majority of homes had attic insulation meeting or exceeding R-19. However, less than 33% in any EDC had R-38 or above.

Table 5-11: Proportion of Attic Insulation R-Value by EDC

R-value Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
R1-R12	2%	11%	15%	9%	10%	4%	11%
R13-R18	3%	11%	14%	6%	11%	22%	15%
R19-R37	76%	58%	57%	57%	46%	65%	68%
R38-R59	15%	15%	12%	26%	29%	9%	3%
R60+	3%	4%	3%	2%	4%	0%	3%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	34	45	35	48	41	24	36

Wall Insulation. The majority of surveyed homes had wall insulation present. The range of homes verified to have no wall insulation ranged from 10%-27%. Surveyors were unable to verify the presence or absence of insulation in 11%-40% of homes based on homes with no access to wall space (typically multifamily or SF-attached homes). N/A refers to homes where wall insulation was not applicable.

Table 5-12: Presence of Wall Insulation by EDC

Insulation Present?	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Yes	40%	71%	67%	70%	67%	32%	53%
No	25%	12%	21%	16%	17%	27%	10%
N/A	2%	0%	0%	0%	0%	1%	0%
Unknown	33%	17%	11%	14%	16%	40%	37%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

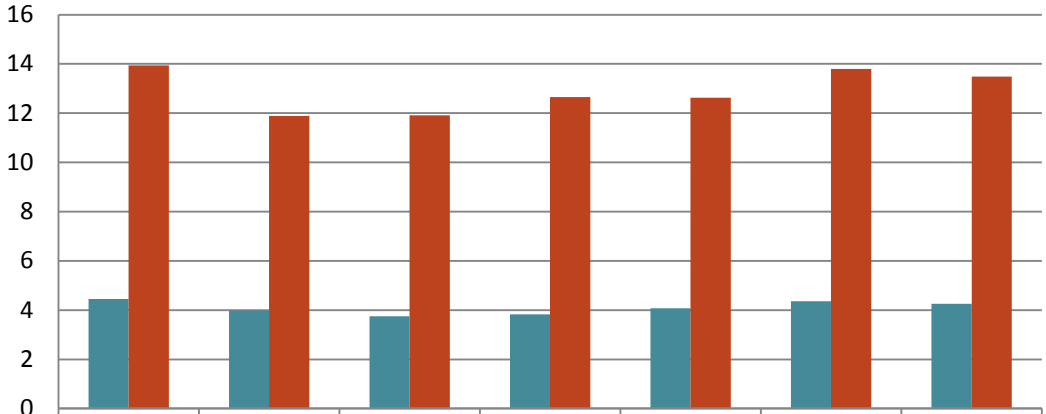
Wall Insulation Type. Fiberglass batting is the predominant form of wall insulation (57% to 88%). Surveyors were not able to determine the type of wall insulation in 3% to 23% of surveyed homes. Other includes dense pack cellulose, rigid board, spray foam, rock wool, etc. Note that not all homes had wall insulation present and the number of total observations is limited.

Table 5-13: Type of Wall Insulation by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Cellulose Loose	4%	0%	0%	9%	0%	14%	9%
Fiberglass Batt	80%	82%	84%	68%	88%	59%	57%
Fiberglass Loose Fill	7%	2%	9%	4%	7%	0%	6%
Other	7%	8%	0%	12%	2%	10%	5%
Unknown	3%	8%	7%	8%	3%	17%	23%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	29	50	47	49	47	22	36

Wall Insulation Thickness. The average thickness of wall insulation across all EDCs was 4 inches. The average insulation R-value, after accounting for insulation thickness and R-valu, ranged from R12 to R14. Due to limited access to wall space, particularly in multifamily units, wall insulation thickness was not determined in all instances where wall insulation was present.

Figure 5-5: Wall Insulation Thickness/R-Value by EDC



	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
Thickness (in.)	4	4	4	4	4	4	4
R-value	14	12	12	13	13	14	13

n	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n (Thickness)	28	44	41	43	44	20	27
n (R-value)	28	44	41	42	44	19	24

For homes with wall insulation, the table below indicates the proportion of insulation by R-value. Very few homes had wall insulation R-values of 19 or greater.

Table 5-14: Proportion of Wall Insulation R-Value by EDC

R-value Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
R1-R12	57%	73%	58%	67%	64%	25%	36%
R13-R18	40%	22%	42%	26%	36%	65%	64%
R19-R37	3%	4%	0%	7%	0%	10%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	28	44	41	42	44	19	24

Basement Wall/Foundation Wall/Frame Floor Insulation. Across the EDCs, in homes with basements and/or crawlspaces, 36% - 59% had either basement/foundation wall or frame floor insulation in their homes. Conversely, 33% to 58% of surveyed homes with basements and/or crawlspaces did not possess insulation in either location.

Table 5-15: Presence of Basement Wall/Foundation Wall or Frame Floor Insulation by EDC

Insulation Present?	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Yes	36%	59%	40%	45%	53%	23%	52%
No	58%	33%	55%	51%	39%	64%	38%
Unknown	6%	8%	6%	4%	8%	14%	10%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	50	59	61	59	58	53	62

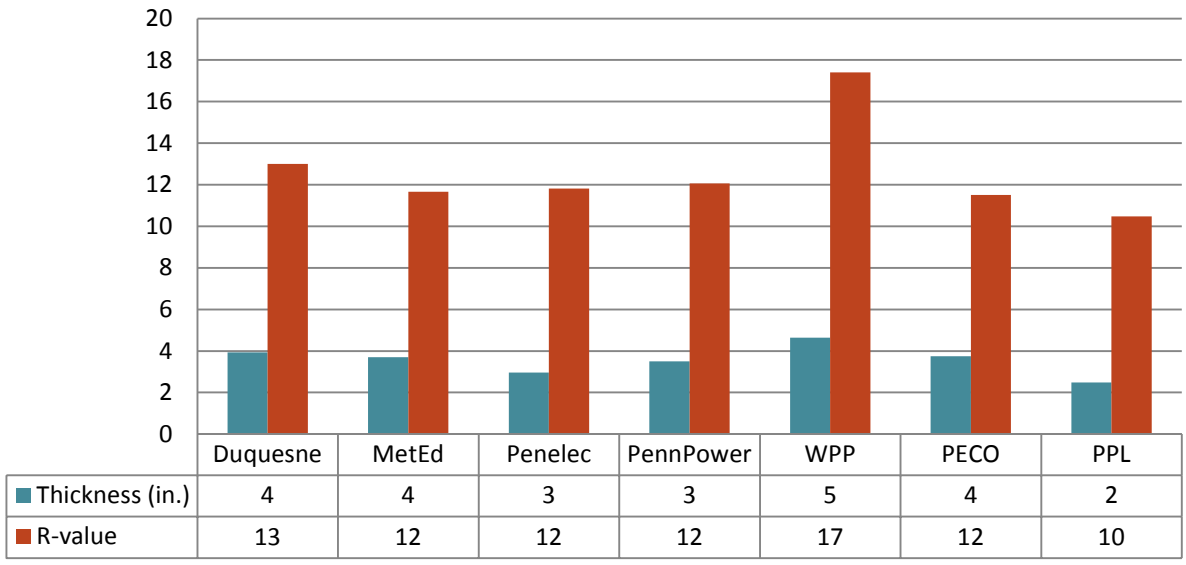
Basement Wall Insulation Type. Fiberglass batting is generally the predominant form of basement wall insulation (24% to 75%). Note the limited number of observations available for basement wall insulation. These limited observations restrict the level of confidence of reported statistics.

Table 5-16: Basement Wall Insulation Type by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Fiberglass Batt	55%	58%	53%	45%	65%	75%	24%
Fiberglass Loose Fill	0%	0%	0%	0%	0%	25%	0%
Rigid Board	9%	16%	0%	12%	14%	0%	41%
Other	9%	22%	35%	18%	9%	0%	13%
Unknown	26%	5%	12%	25%	12%	0%	21%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	11	19	9	19	23	4	13

Basement Wall Insulation Thickness. In surveyed homes with basement wall insulation, the average thickness of insulation ranged from 2 inches to 5 inches. The average R-value ranged from R10 to R17. Note the limited number of observations available for basement wall insulation based on the overall number of homes where basement wall insulation was either applicable or present, as well as surveyor ability to determine thickness and R-value in these homes. These limited observations restrict the level of confidence of reported statistics.

Figure 5-6: Basement Wall Insulation Thickness/R-Value by EDC



n	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n (Thickness)	7	16	7	12	16	4	10
n (R-value)	6	16	6	12	16	4	9

Floor Insulation Type. Fiberglass batting is the predominant form of floor insulation when insulation is present (75% to 95%). Note that only a subset of the surveyed homes possesses floor insulation (either

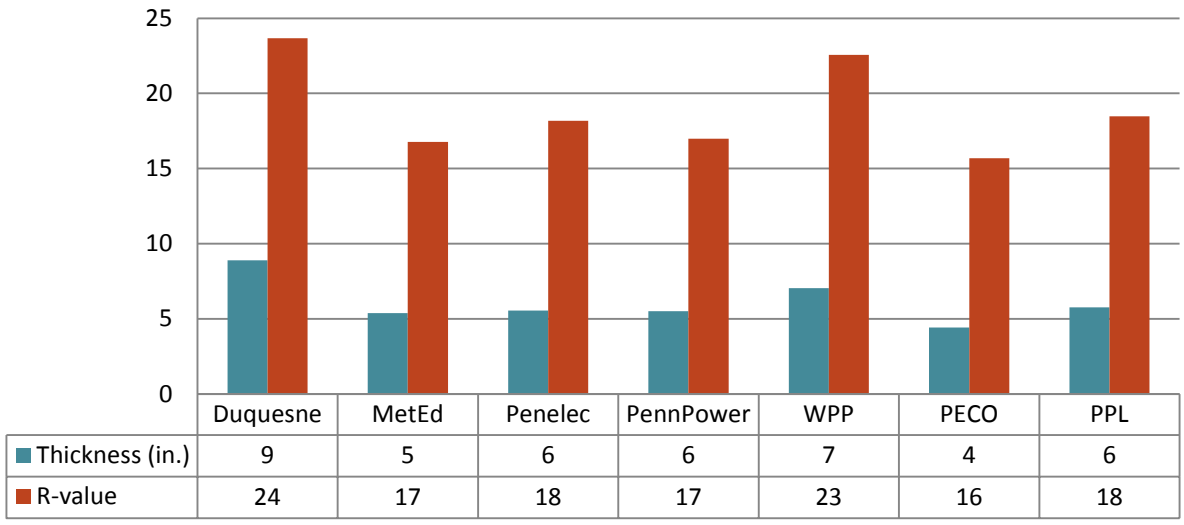
because floor insulation was not applicable, present, or verified). As a result, the number of observations available for this metric is limited.

Table 5-17: Floor Insulation Type by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Fiberglass Batt	75%	92%	95%	93%	84%	92%	85%
Other	0%	4%	0%	0%	0%	8%	9%
Unknown	25%	4%	5%	7%	16%	0%	7%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	12	28	21	15	19	9	26

Floor Insulation Thickness. In surveyed homes with floor insulation present, the average thickness of insulation ranged from 4 inches to 9 inches. The average insulation R-value, after accounting for insulation thickness and type, ranged from R16 to R24. The limited number of observations available for floor insulation thickness and R-value is based on both the overall number of homes with floor insulation present as well as surveyor ability to determine thickness and R-value characteristics in these homes. These limited observations restrict the level of confidence of reported statistics.

Figure 5-7: Floor Insulation Thickness/R-Value by EDC



n	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n (Thickness)	10	26	18	12	13	9	22
n (R-value)	9	25	18	12	13	8	22

For homes with floor insulation, the table below indicates the proportion of insulation by R-value. The majority of homes with floor insulation present were found to have R-13 or greater insulation.

Table 5-18: Proportion of Floor Insulation R-Value by EDC

R-value Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
R1-R12	0%	36%	26%	34%	23%	13%	19%
R13-R18	0%	12%	24%	17%	8%	49%	26%
R19-R37	80%	48%	45%	49%	44%	38%	55%
R38+	20%	4%	5%	0%	26%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	10	25	18	12	13	8	22

5.3.2 Windows

Number of Windows. The average number of windows per surveyed household ranged from 14 to 19 windows. The minimum number of windows per household was 1 windows and the maximum was 76 windows.

Table 5-19: Average Number of Windows per Household by EDC

# of Windows	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Avg. # of Windows	15	19	15	18	16	14	16
Max. # of Windows	76	63	40	49	44	38	42
Min. # of Windows	1	3	3	3	1	2	2
n	70	70	70	70	70	70	70

Total Window Area. The average total square footage of window area per household ranged from 143 sq. ft. (Duquesne) to 191 sq. ft. (Penn Power).

Table 5-20: Average Area of Window Area per Household by EDC

Avg. Window Area	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Square Feet	143	166	173	191	161	176	168
n	70	70	70	70	70	70	70

Glazing Type. The table below describes the glazing types present at the surveyed homes. The majority of windows were double-paned. Less than 3% are triple-paned across all EDCs and 3% to 18% were considered single-paned. Where surveyors were unable to determine the presence of low-E coating, windows were assumed to be standard double-paned.

Table 5-21: Window Glazing Type by EDC

# of Windows	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Single-paned	11%	14%	16%	18%	3%	11%	4%
Double-paned	58%	62%	57%	52%	62%	63%	77%
Low-E DP	31%	21%	23%	30%	35%	21%	19%
Triple-paned	0%	3%	3%	0%	1%	5%	1%
n	1069	1336	1022	1237	1051	954	1095

5.3.1 Roofs

Roof Color. The majority of surveyed homes have dark roofs (between 67% and 75%). The remainder of surveyed homes had mostly light colored roofs, with only very small percent (0% to 4%) having white roofs.

Table 5-22: Roof Color by EDC

Roof Color	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Dark Color	69%	75%	68%	67%	51%	74%	72%
Light Color	29%	23%	30%	28%	41%	23%	25%
Reflective	2%	1%	3%	5%	8%	3%	3%
n	67	69	68	70	68	67	70

5.3.2 Air Sealing

Air Sealing. Air Sealing was assessed qualitatively by surveyors by checking for possible areas of leakage around doors, windows, recessed cans, and other gaps in the thermal envelope. Surveyed homes were assessed as either: well-sealed, partially sealed, or poorly sealed. Poorly sealed homes ranged from 12% to 35% of all homes across the EDCs.

Table 5-23: Quality of Air Sealing by EDC

Air Seal Qual.	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Well Sealed	39%	36%	27%	54%	41%	22%	41%
Partially Sealed	39%	39%	32%	26%	38%	57%	46%
Poorly Sealed	17%	23%	35%	18%	19%	15%	12%
Unable To Assess	4%	1%	5%	2%	3%	7%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

5.3.3 Duct Sealing

Duct Location. Where ducts were present, more than half of a home's ductwork was located in unconditioned space (typically basements, crawlspaces, and/or attics) in approximately 17%-39% of the surveyed homes across the EDCs. Ninety percent or more of a home's ductwork was located in conditioned space in 43%-62% of homes. Across the EDCs, 71%-90% of the ductwork located outside of conditioned space was found in unconditioned basements, with the remaining ductwork located in attics or crawlspace.

Responses were omitted when the surveyor was unable to confirm the location of the ductwork; the final number of observations (n) per EDC is included below.

Table 5-24: Duct Location by EDC

Duct Location	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
< 50% Conditioned	31%	39%	23%	33%	31%	38%	17%
50%-90% Cond.	10%	18%	16%	26%	8%	16%	27%

Duct Location	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
>90% Cond.	58%	43%	61%	41%	62%	46%	56%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	48	51	39	62	54	43	37

Table 5-25: Unconditioned Space Duct Location by EDC

Duct Location	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Attic	5%	22%	8%	13%	17%	29%	13%
Crawl space	5%	5%	4%	8%	10%	0%	9%
Uncond. basement	90%	73%	88%	79%	73%	71%	78%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	20	37	24	52	30	28	32

Duct Insulation. Where ductwork was located outside of conditioned space, surveyors recorded the level of duct insulation present in the home. Across the EDCs, a wide range (32%-74%) of ductwork located in unconditioned space had R-4 insulation or less. An additional 18%-49% of ductwork in unconditioned space had between R-4 and R-7. Again, note that these observations are limited to homes with ductwork in unconditioned space and where the surveyor was able to confirm the level of insulation; the final number of observations (n) is included below.

Table 5-26: Duct Location by EDC

Insulation Level	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Less than R-4	64%	32%	58%	71%	57%	74%	42%
R-4 – R-7	18%	45%	32%	18%	28%	20%	49%
R-8 or greater	19%	22%	10%	11%	14%	6%	9%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	22	37	30	52	34	34	27

Duct Sealing. The table below presents a qualitative assessment of duct sealing in homes with existing ductwork.

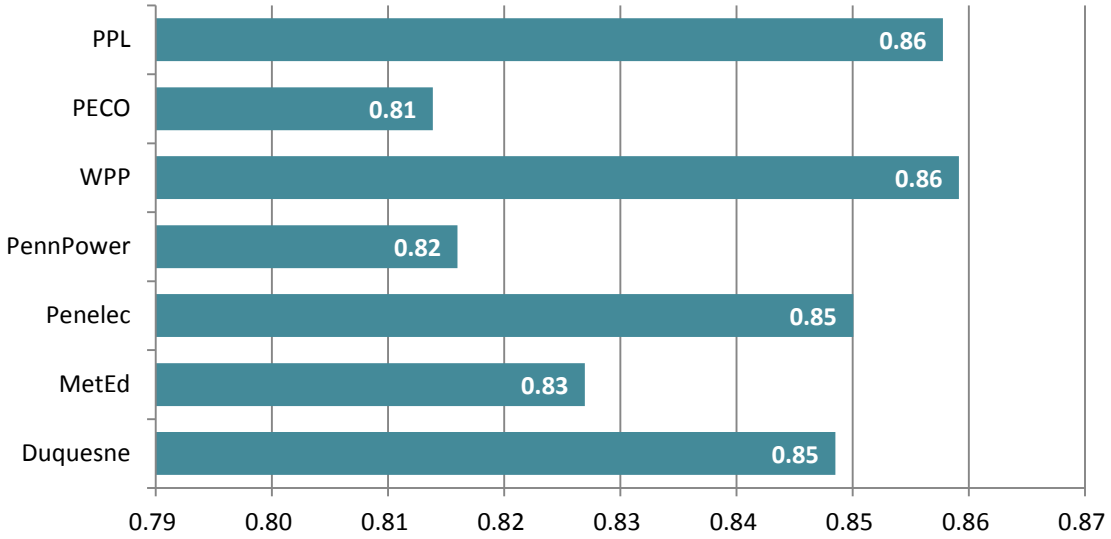
Table 5-27: Quality of Duct Sealing by EDC

Duct Seal Qual.	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Sealed with Mastic	27%	30%	20%	5%	41%	9%	31%
No observable leaks	43%	44%	44%	55%	23%	30%	35%
Some observable leaks	30%	26%	33%	36%	34%	58%	31%
Significant leaks	0%	0%	3%	3%	2%	2%	4%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

In addition to the qualitative assessment, the surveyors combined three of the data fields (% within conditioned space, insulation on ductwork located outside the conditioned space, and the qualitative

assessment of air sealing) to create an index of duct efficiency. This index was modeled after the Building Performance Institute's Distribution Efficiency Look-Up Table. The calculated distribution efficiency of the duct systems are provided below.

Figure 5-8: Distribution Efficiency of Ductwork by EDC



5.4 RESIDENTIAL HVAC

This section presents details on the residential space heating and cooling systems present at the surveyed homes.

5.4.1 Space Heating & Cooling Combination

Heating & Cooling Equipment Combination. The table below presents the space heating and space cooing equipment combinations present in households across the EDCs. Households with primary non-electric heating systems and central AC cooling are typically the most common statewide, followed by households with primary non-electric heat with Room AC cooling and homes with primary electric heat and central AC units.

Table 5-28: Heting & Cooling Equipment Combinations by EDC

Temp Set Points	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
NON-ELECTRIC HEATING							
Central AC	51%	45%	28%	48%	44%	37%	32%
Room AC	27%	23%	41%	11%	21%	33%	30%
CAC & RAC	4%	7%	1%	1%	5%	6%	3%
No Cooling	9%	4%	19%	9%	8%	1%	5%
ELECTRIC HEATING							
Central AC	6%	8%	5%	19%	14%	17%	17%

Temp Set Points	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Room AC	3%	9%	6%	7%	5%	5%	6%
CAC & RAC	0%	1%	0%	0%	3%	0%	1%
No Cooling	0%	1%	1%	4%	1%	0%	6%
n	40	43	24	45	45	44	40

5.4.2 Space Heating

Primary Fuel Type. Natural gas was the most prominent heating fuel found in residential homes (39%-87%), with the exception of PPL (only 29% of primary heating systems). Electric systems and oil systems were also fairly common in select EDCs. The saturation of electric primary heating systems ranged from 9% (Duquesne) to 30% (Penn Power & PPL). The remaining fuel types include coal, propane, wood, etc.

Table 5-29: Fuel Type of Primary Space Heating Systems by EDC

Prim. Fuel Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Natural Gas	87%	39%	46%	54%	60%	57%	29%
Electric	9%	20%	12%	30%	22%	22%	30%
Coal	0%	0%	3%	0%	0%	0%	7%
Dual Fuel	0%	1%	0%	1%	0%	0%	2%
Kerosene	1%	0%	3%	0%	0%	0%	1%
Oil	3%	22%	27%	7%	14%	15%	23%
Propane	0%	10%	3%	1%	2%	6%	6%
Wood	0%	7%	6%	6%	2%	0%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	69

Secondary Fuel Type Systems. For homes with secondary heating systems that utilize a different fuel type than the primary system, the most common secondary fuel type is electric. However, note the small sample size in most EDCs. Sample sizes below 68 do not meet a 90/10 level of confidence.

Table 5-30: Fuel Type of Secondary Space Heating Systems by EDC

Second. Fuel Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Natural Gas	20%	4%	0%	0%	50%	17%	5%
Electric	80%	48%	35%	45%	0%	67%	63%
Coal	0%	0%	7%	0%	0%	0%	0%
Oil	0%	9%	3%	11%	0%	0%	5%
Propane	0%	13%	19%	0%	0%	0%	18%
Wood	0%	26%	35%	43%	50%	17%	9%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	**5**	**23**	**15**	**9**	**6**	**6**	**21**

Primary System Type. Between 36% and 75% of primary heating systems are central furnaces. The next most common systems are typically boilers, heat pump and baseboard systems.

Table 5-31: System Type of Primary Space Heating Systems by EDC

Prim. System Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Central Furnaces	68%	45%	52%	75%	73%	56%	36%
Boilers	22%	25%	27%	6%	12%	24%	24%
Heat Pumps	1%	6%	3%	11%	7%	11%	17%
Baseboard	2%	12%	6%	4%	2%	2%	12%
Other	5%	4%	3%	1%	4%	5%	2%
Space Heaters	3%	0%	3%	1%	1%	2%	2%
Stoves	0%	8%	5%	1%	0%	0%	7%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	69

Primary Electric Heating System Type. Although there is only a limited sample of primary electric heating systems within each EDC, the system type among electric space heating is shown below for comparison. Air Source Heat Pumps are typically the most common, ranging from 14% (Duquesne) to 43% (PPL) across the EDCs. Baseboard and central furnaces are also common forms of primary electric heating.

Table 5-32: System Type of Primary Electric Heating Systems by EDC

Elec. System Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Air Source HP	14%	19%	26%	16%	24%	42%	43%
Geothermal HP	0%	0%	0%	14%	7%	0%	5%
Dual Fuel HP	0%	6%	0%	5%	0%	0%	5%
Ductless HP	0%	0%	0%	0%	0%	5%	0%
Baseboard	17%	54%	37%	11%	10%	11%	39%
Furnace	17%	0%	12%	50%	46%	31%	8%
Wall Mount. Space	17%	0%	0%	0%	0%	11%	0%
Other	35%	20%	26%	4%	13%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	6	15	8	22	16	16	22

Secondary System Type. Baseboard heating and central furnaces are common secondary systems across all EDCs. Heat Pumps, electric space heating and wood/coal stove heating are also common forms of back-up heating systems across the EDCs. However, note that due to small number of homes with back-up space heating, the number of observations for this data is significantly limited.

Table 5-33: System Type of Secondary Space Heating Systems by EDC

2nd System Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Air Source HP	20%	18%	0%	0%	0%	17%	0%
Baseboard	60%	24%	14%	11%	0%	17%	48%
Boiler (Water)	0%	4%	10%	0%	0%	17%	0%
Ductless HP	0%	0%	7%	0%	0%	34%	0%
Furnace	20%	13%	5%	45%	0%	0%	5%
Other	0%	9%	0%	0%	50%	0%	13%

2nd System Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Wall Mount. Space	0%	4%	28%	0%	17%	0%	20%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	5	22	15	9	6	6	21

Heating System Age. The average heating system is between 11 and 18 years old across the EDCs.

Table 5-34: Average Heating System Age by EDC

Avg. Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Years	12	18	18	11	13	13	17
n	58	89	86	70	75	75	95

The percentage of heating systems that were estimated by homeowners to be 15 years of age or older ranges from 25% in the Duquesne territory to 49% in the PPL service area. Heating systems that were estimated to be less than 5 years of age range from 9% in the Penelec service area to 28% in the Duquesne area.

Table 5-35: HVAC System Age Range by EDC

HVAC Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	28%	13%	9%	29%	21%	22%	11%
5-9 Years	22%	22%	19%	33%	13%	22%	25%
10-14 Years	25%	20%	33%	11%	22%	17%	15%
15-19 Years	7%	8%	3%	5%	26%	18%	9%
20 Years or Older	17%	38%	37%	21%	17%	20%	40%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	33	49	20	41	40	45	31

Heating Maintenance. The majority of homeowners reported that they had recently (within the last two years) had a seasonal tune-up performed on their heating systems. Between 24% and 48% reported they had never had a seasonal tune-up performed on their heating systems.

Table 5-36: Time since Last Seasonal Tune-Up (Heating Systems) by EDC

HVAC Last Tuned?	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Equip. < 1 year old	0%	5%	2%	2%	0%	7%	2%
Less than 1 year	36%	36%	13%	47%	46%	37%	38%
1-2 years	21%	28%	31%	18%	21%	22%	25%
More than 2 years	2%	8%	7%	14%	9%	8%	2%
Never (Repair Only)	42%	24%	48%	19%	24%	26%	33%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	63	64	63	63	65	60	67

5.4.3 Space Cooling

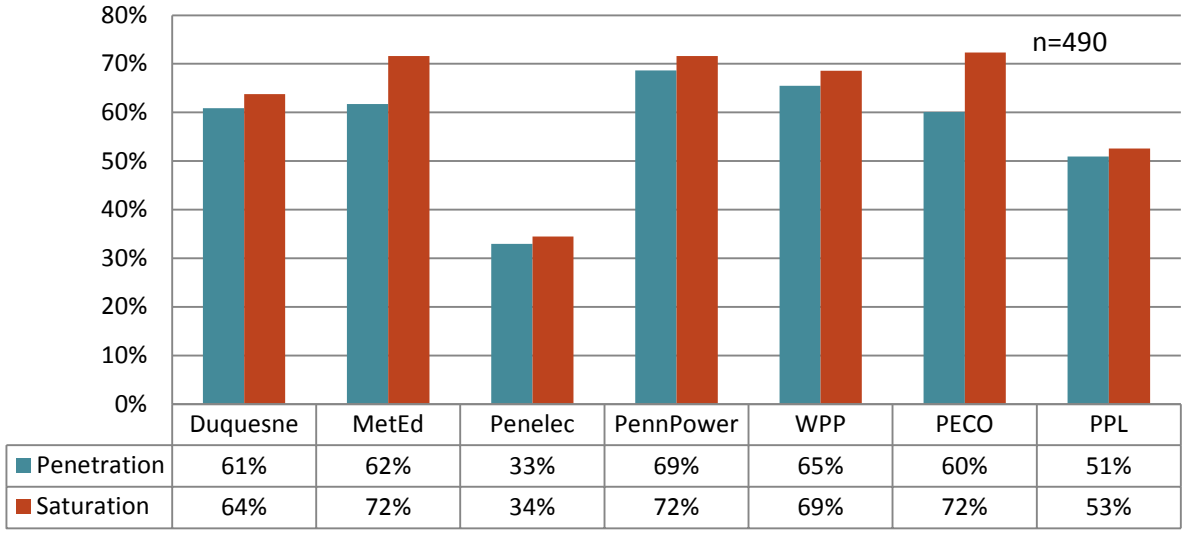
Penetration of Central AC Systems. The penetration of central air conditioning systems (including heat pump systems) varies across the EDCs. Across most EDCs the majority of homeowners have central AC systems (51%-69%) By comparison, only 33% of the surveyed homes in the Penelec area were equipped with Central AC systems. Of homes with central AC systems, a relatively small number of homes had more than one system.

Table 5-37: Penetration of Central AC Systems by EDC

#	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0	39%	38%	67%	31%	35%	40%	49%
1	58%	53%	31%	66%	62%	49%	49%
2	3%	7%	2%	3%	3%	9%	2%
3+	0%	1%	0%	0%	0%	2%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

Saturation of Central AC Systems. The saturation of primary Central AC systems ranges from 34% to 72%. The saturation of secondary systems in the surveyed homes ranged from 2% to 13% across the EDCs.

Figure 5-9: Saturation of Central AC Systems by EDC



	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
Penetration	61%	62%	33%	69%	65%	60%	51%
Saturation	64%	72%	34%	72%	69%	72%	53%

Central AC System Type. While traditional central AC systems are the predominant system type for cooling (range of 65% to 91% across the seven EDCs), nearly every EDC also demonstrated the presence of air-source heat pump systems, mini-split systems, or geothermal systems.

Table 5-38: Central Air Conditioning System Type by EDC

CAC Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PPL	PECO
Central AC	91%	79%	87%	79%	87%	75%	65%
GSHP	0%	0%	0%	6%	2%	0%	3%
Heat Pump	4%	15%	9%	13%	11%	17%	32%
Ductless AC	0%	6%	0%	0%	0%	2%	0%
Ductless HP	0%	0%	4%	0%	0%	6%	0%
Other	5%	0%	0%	2%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	45	51	24	51	49	49	37

Central AC SEER Rating. The Central AC efficiency was infrequently provided on the equipment, but where the make and model were available the SWE team recorded and researched manufacturer data. The majority of Central AC systems (including heat pumps) were found to currently have a SEER rating below current federal minimum standards (SEER 13). Less than 13% of all Central AC systems (including heat pumps, geothermal and mini split systems) across all the EDCs were found to currently meet ENERGY STAR criteria of 14.5 SEER or better.

Table 5-39: Central AC System SEER Ratings by EDC

SEER Rating	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Below 13	44%	49%	39%	30%	46%	28%	36%
13	13%	14%	16%	27%	12%	25%	29%
14	5%	14%	0%	4%	7%	4%	9%
14.5 or above	9%	8%	4%	10%	9%	13%	5%
Unknown	29%	16%	41%	27%	26%	26%	12%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	43	51	24	50	49	49	37

This table includes the Central AC systems where the SEER rating was unable to be determined. It is probable that a majority of these unknown systems are currently at or below the current minimum standard as manufacturer data was often unavailable for older systems. Also, note that the sample size is limited for Central AC systems as not all households currently are equipped with Central AC systems.

Central AC System Age. The average central cooling system (including heat pump systems) is between 9 and 12 years old.

Table 5-40: Average Central AC System Age by EDC

Avg. Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Years	12	11	12	10	10	9	9
n	33	49	20	41	40	45	31

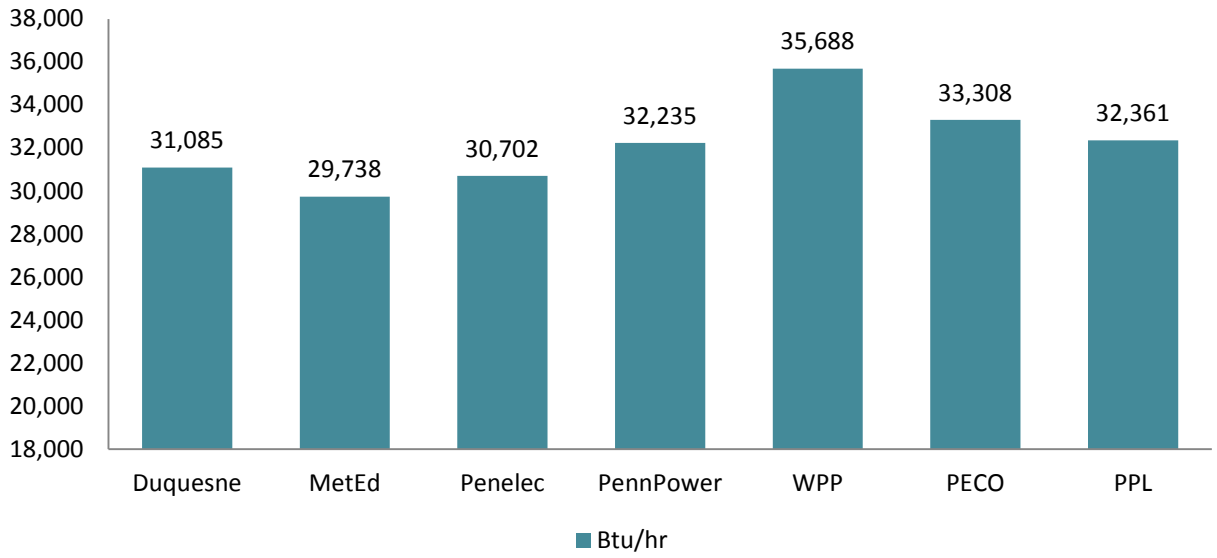
The table below presents the age range of central AC systems surveyed for each of the EDCs. Throughout most EDC's, 38% or more of central AC systems were estimated to be older than 10 years of age. The number of observations is limited to those homes where Central AC systems were present.

Table 5-41: Central AC System Age Range by EDC

AC Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	20%	14%	11%	34%	35%	27%	19%
5-9 Years	25%	39%	30%	27%	8%	27%	42%
10-14 Years	20%	17%	31%	14%	34%	27%	25%
15-19 Years	14%	10%	10%	6%	14%	10%	6%
20 Years or Older	21%	20%	19%	18%	10%	9%	7%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	33	49	20	41	40	45	31

AC Capacity. The average cooling capacity of central cooling systems (including heat pumps) in homes ranged from approximately 30,000 -36,000 btu/hr.

Figure 10: Average Central AC Cooling Capacity by EDC



	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	36	46	17	43	39	40	32

AC System Maintenance. The majority of homeowners reported that they had recently (within the last two years) had a seasonal tune-up performed on their AC system. Between 14% and 59% reported they had never had a seasonal tune-up performed on their AC systems.

Table 5-42: Time since Last Seasonal Tune-Up (Cooling Systems) by EDC

AC Last Tuned?	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Equip. < 1 year old	3%	2%	0%	2%	0%	7%	5%
Less than 1 year	32%	44%	12%	43%	53%	37%	50%
1-2 years	13%	28%	15%	26%	27%	19%	7%
More than 2 years	5%	9%	13%	14%	7%	0%	8%

AC Last Tuned?	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Never (Repair Only)	48%	16%	59%	15%	14%	37%	30%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	40	43	24	45	45	44	40

Penetration of Room AC Systems. The penetration of room air conditioning systems varies across the EDCs. Between 20% and 48% of homes surveyed have at least one room air conditioner. In addition, 8%-30% of the surveyed homes have two or more air conditioners per household.

Table 5-43: Penetration of Room Air Conditioners by EDC

#	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0	65%	59%	52%	80%	66%	55%	58%
1	20%	18%	24%	12%	15%	19%	12%
2	8%	13%	14%	8%	15%	14%	15%
3+	6%	10%	10%	0%	3%	12%	15%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

Saturation of Room AC Systems. The total saturation of room air conditioners by EDC ranged from only 28% (Penn Power) to 97% (PECO).

Table 5-44: Saturation of Room Air Conditioners by EDC

RAC	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Saturation	56%	80%	87%	28%	61%	97%	96%
n	70	70	70	70	70	70	70

Room AC Age. The average estimated age of room air conditioning units ranged from 5 – 8 years of age across the EDCs.

Table 5-45: Average Age of Room Air Conditioning Units by EDC

Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Average (Years)	5	6	8	6	8	8	6
n	24	51	49	17	32	59	52

Table 5-46: Room Air Conditioning Unit Age Range by EDC

Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	54%	46%	40%	40%	48%	18%	41%
5-9 Years	29%	31%	19%	40%	22%	48%	44%
10-14 Years	8%	15%	25%	12%	9%	23%	10%
15-19 Years	8%	8%	9%	0%	6%	6%	4%
20 Years or Older	0%	0%	7%	8%	15%	5%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	33	49	20	41	40	45	31

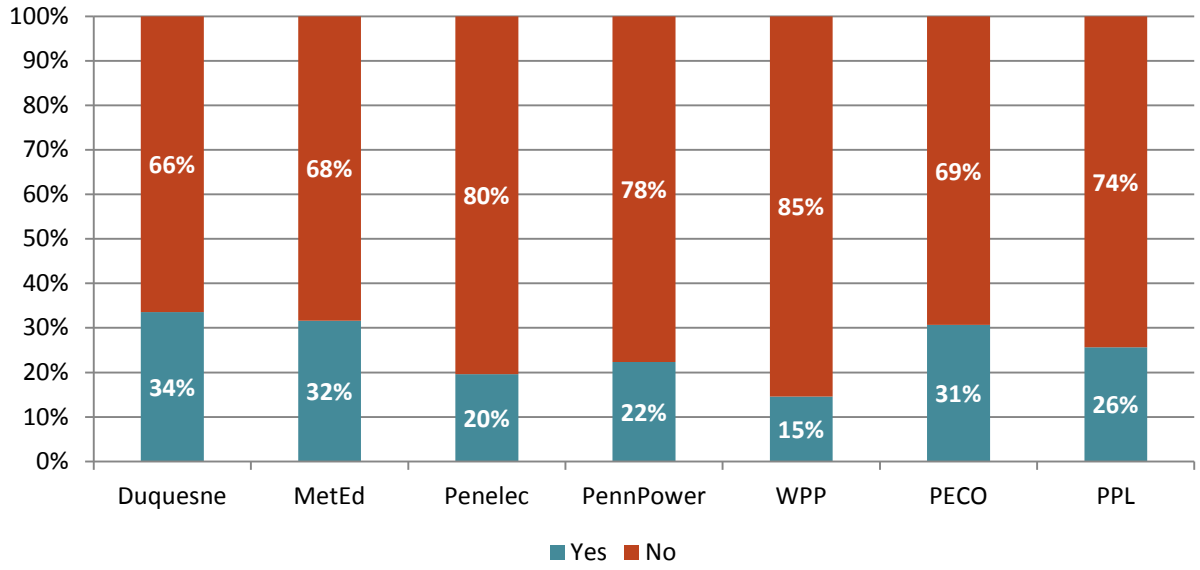
Room AC Capacity. Across the EDCs the average cooling capacity of room air conditioning units range from roughly 7,000 btu/hr in the PECO service area to nearly 10,000 btu/hr in the Penn Power service area.

Table 5-47: Average Cooling Capacity of Room Air conditioning Units by EDC

Capacity	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Average (Btu/hr)	8,342	7,468	7,420	9,667	8,238	6,950	8,586
n	32	48	45	15	29	54	58

ENERGY STAR Room Air Conditioners. 15% - 34% of room air conditioners were ENERGY STAR rated across the EDCs. The SWE team documentation of ENERGY STAR Room ACs was based on the ability to visually detect the label or determine that a particular model was ENERGY STAR rated by searching for the make and model number on the ENERGY STAR website or manufacturer data. The number of room air conditioners with make/model number detail available is listed to demonstrate the limited sample size associated with this metric.

Figure 5-11: ENERGY STAR Room Air Conditioners by EDC



	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	39	55	61	20	40	67	68

5.4.4 Other

Programmable Thermostats. Roughly half of Central HVAC systems had a programmable thermostat installed, ranging from 41% (Penelec) to 63% in the Duquesne service area. Homes without central systems were not included in this metric.

Table 5-48: Programmable Thermostats by EDC

Prog. Thermostat	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
No	37%	48%	59%	40%	43%	47%	55%
Yes	63%	52%	41%	60%	57%	53%	45%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	41	44	23	48	47	41	36

Thermostat Set-Points. Across the EDCs homeowners generally set their thermostat during the heating season to 67 – 70 degrees Fahrenheit while at home. During the cooling season, the AC thermostat was set to between 71-74 degrees Fahrenheit. While away from home, homeowners generally lowered their thermostat during the heating season to reduce heating times and raised their thermostat during the cooling season to reduce cooling times.

Table 5-49: Heating and Cooling System Temperature Set Points by EDC

Temp Set Points	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
HEATING (Degrees Fahrenheit)							
Awake	69	69	68	69	69	70	69
Asleep	68	68	67	68	68	67	68
Away	67	67	65	66	66	67	67
n	66	55	62	67	64	64	63
COOLING (Degrees Fahrenheit)							
Awake	73	73	74	72	73	74	74
Asleep	73	72	74	72	71	74	74
Away	74	74	77	75	72	77	74
n	40	43	24	45	45	44	40

5.5 LIGHTING

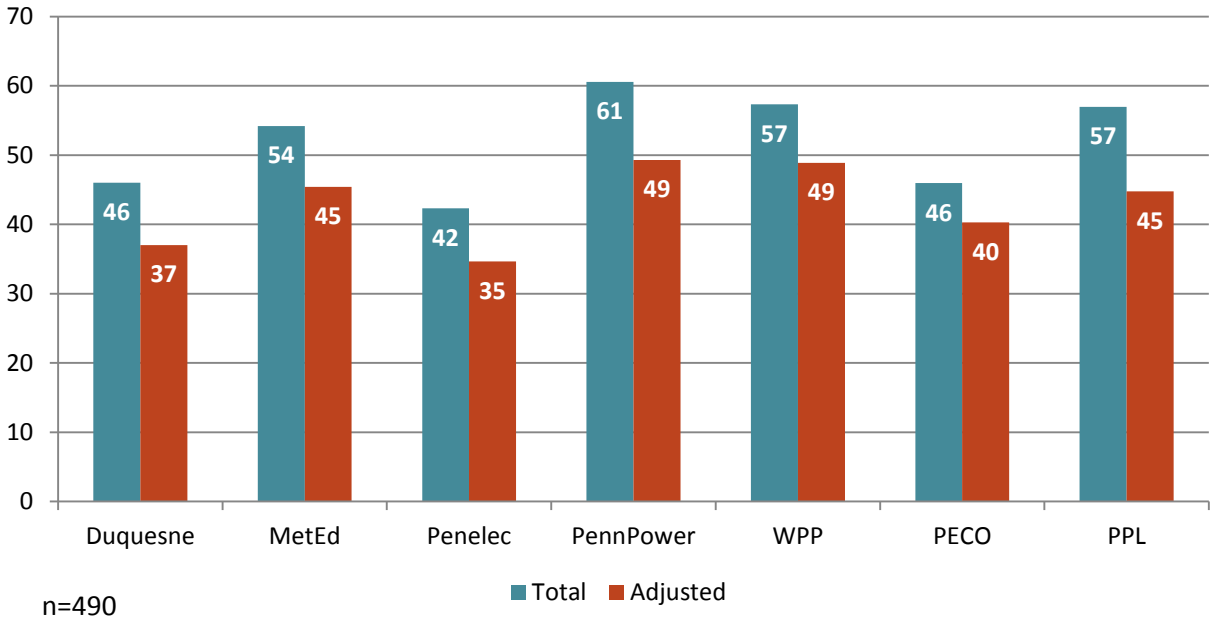
This section presents details on the lighting equipment used in the surveyed residential sites.

5.5.1 Sockets per Home

Interior Sockets per Home. The average number of interior sockets per home ranges from a low of 42 in the Penelec service area to 61 sockets in the Penn Power area. These include all Edison-base, candelabra, pin-based and empty sockets found in homes and conditioned spaces. Exterior lighting is not included in this socket count.

Adjusted Interior Sockets per Home. After accounting for empty sockets, tube fluorescent lighting, nightlights and pin-based bulbs, the total number of sockets per home reduces to a range of 35 to 49 sockets per home. This socket count aims to represent the total number of sockets eligible for CFL placement by removing sockets where CFL bulbs cannot easily be retrofitted.

Figure 5-12: Adjusted Number of Interior Sockets per Home by EDC



Total Exterior Sockets per Home. The average number of total exterior sockets per home ranges from 4-7 sockets across the EDCs.

Adjusted Exterior Sockets per Home. The average number of adjusted exterior sockets per home ranges from 4-6 sockets across the EDCs. Adjusted exterior sockets exclude pin-based sockets, sockets with no installed bulb, and unknown bulb/socket types.

Table 5-50: Exterior Sockets per Home by EDC

# of Sockets	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Total Avg. per Home	4	7	4	5	6	4	6
Adj. Avg. per Home	4	6	4	5	6	4	5
n	70	70	70	70	70	70	70

5.5.2 Bulb Type

Penetrations by Interior Bulb Type. The table below presents the penetration of interior lighting by bulb type. Nearly all homes have incandescent lighting. At least one compact fluorescent light (CFL) bulb can be found in 85% to 93% of residences. LED bulbs, including nightlights, are found in 5% to 30% of homes. Modified halogen general purpose bulbs designed to meet EISA standards were found in 10%

of homes or less across the seven EDCs. Tube fluorescent lighting is found in approximately 60%-79% of residences.

Table 5-51: Penetration of Lighting by Interior Bulb Type by EDC

Bulb Type (Penetration)	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Incandescent	98%	99%	99%	98%	97%	99%	99%
CFL	87%	93%	85%	90%	92%	86%	91%
LED	21%	22%	16%	14%	11%	5%	30%
Modified Halogen	1%	8%	5%	10%	3%	5%	5%
Halogen	32%	35%	23%	24%	24%	27%	44%
Tube Fluorescent	61%	63%	72%	67%	70%	60%	79%
Other	9%	13%	18%	14%	13%	7%	16%
n	70	70	70	70	70	70	70

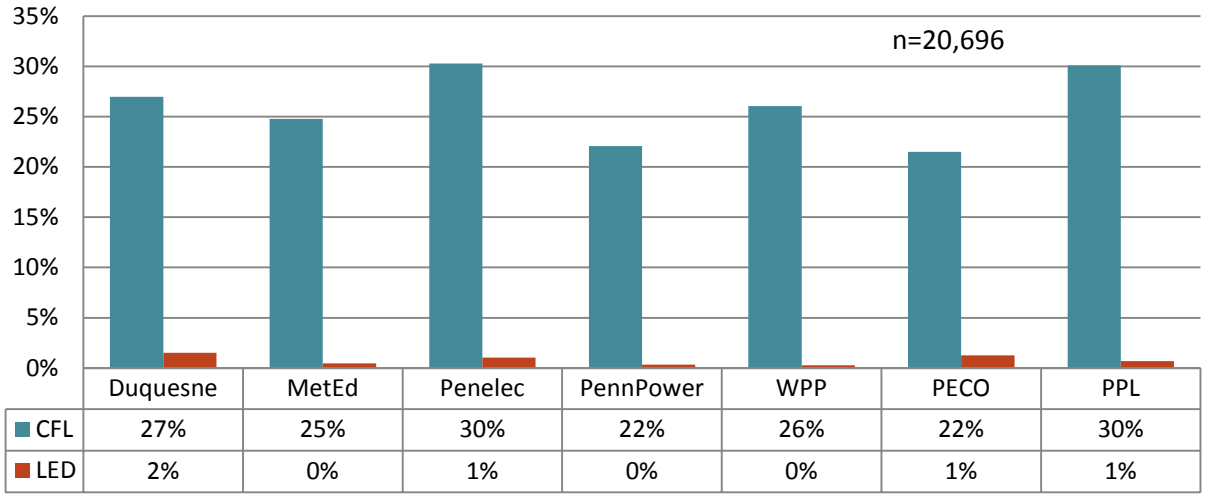
Saturations by Interior Bulb Type. Depending on the EDC, incandescent bulbs account for anywhere between 53% and 67% of all sockets in residences throughout Pennsylvania. While CFLs can be found in over two-thirds of houses (in six out of seven EDCs), CFL bulbs only account for 18% to 25% of all sockets. Tube fluorescent and halogen bulbs make the dominant majority of remaining sockets.

Table 5-52: Saturation of Lighting by Interior Bulb Type by EDC

Bulb Type (Saturation)	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Incandescent	53%	60%	55%	62%	62%	67%	51%
CFL	22%	21%	25%	18%	22%	19%	24%
LED	2%	2%	2%	4%	1%	2%	3%
Modified Halogen	0%	1%	1%	0%	0%	0%	0%
Halogen	10%	5%	3%	4%	4%	2%	7%
Tube Fluorescent	12%	12%	14%	10%	10%	9%	14%
Other	1%	0%	1%	1%	0%	1%	1%
n	3211	3845	2905	4228	3859	3089	3824

CFL/LED Saturations based on Adjusted Interior Sockets. The table below presents the saturation of CFL and LED bulbs as a percent of sockets where high efficiency lighting could reasonably be achieved and excludes sockets where CFL/LED placement would be difficult or unrealistic.

Figure 5-13: CFL/LED Saturations Based on Eligible Sockets by EDC



	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
CFL	27%	25%	30%	22%	26%	22%	30%
LED	2%	0%	1%	0%	0%	1%	1%

Standard vs. Specialty Bulbs. In sockets where high efficiency lighting could reasonably be achieved, more than two-third of bulbs were considered to be standard across the EDCs. Roughly 1%-22% were considered specialty, with the remaining bulbs considered as reflector bulbs. In this analysis, standard bulbs refer to medium-base A-lamp and medium-base candle-shape bulbs. Specialty bulbs refer to candelabra/small screw base, globe, bullet, and other shapes other than A-lamp bulbs.

Table 5-53: Standard vs. Specialty Bulbs by EDC

Bulb (Saturation)	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Reflector	11%	10%	3%	12%	12%	13%	10%
Specialty	15%	17%	14%	18%	15%	22%	15%
Standard	74%	73%	83%	70%	72%	66%	75%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	3211	3845	2905	4228	3859	3089	3824

The saturation of high efficient lighting (CFL & LED bulbs) among standard, specialty, and reflector bulbs is shown below. In the homes survey, standard bulbs were much more likely to be efficient than specialty and reflector bulbs.

Table 5-54: Efficient (CFL/LED) Lighting in Standard vs. Specialty Bulbs by EDC

% High Efficiency	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Reflector	19%	15%	24%	8%	9%	8%	13%
Specialty	5%	4%	2%	1%	4%	4%	5%
Standard	35%	32%	36%	30%	34%	32%	38%
n	3211	3845	2905	4228	3859	3089	3824

CFL/LED Saturations by Adjusted Exterior Sockets. CFL saturations range from 12% to 24% of exterior sockets where high efficiency lighting could reasonably be achieved and excludes sockets where CFL/LED placement would be difficult or unrealistic. LED saturations remain quite low, ranging from 0.4% to 4.2% of eligible exterior sockets across the seven EDCs.

Table 5-55: Saturation of Lighting by Exterior Bulb Type by EDC

Bulb Type (Saturation)	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
CFL	20.9%	15.2%	19.7%	20.3%	11.8%	17.9%	24.2%
LED	1.5%	0.5%	2.7%	0.4%	1.1%	0.8%	4.2%
n	274	429	277	359	392	248	274

5.5.3 Bulb Wattage

Average Wattage by Interior Bulb Type. The table below presents the average wattage of interior lighting by bulb type. The average wattage of incandescent bulbs ranged between 55W and 57W, suggesting a heavier mix of 40W and 60W bulbs than 75W to 100W bulbs in interior sockets. The average wattage of CFL bulbs ranges from 15W to 17W.

Table 5-56: Average Wattage by Bulb Type by EDC

Avg. Wattage	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
CFL	16	16	15	16	17	17	15
Halogen	44	68	68	56	58	47	46
Incandescent	55	56	55	55	56	55	57
LED	12	9	5	4	2	8	5
Modified Halogen	n/a	59	40	39	61	54	48
Tube Fluorescent	33	36	37	43	43	37	38
n (for CFL Wattage)	690	786	720	796	845	578	903

5.5.4 Lighting Saturations by Room

Socket by Room Type. Across the EDCs the most common location for lighting was found in bedrooms, followed closely by other typically high and medium use areas such as bathrooms, basements, kitchens, hallways, dens, and living rooms. Closets, garages, and other rooms (i.e. storage, other, etc.) are common low daily use areas, and represent roughly 12% of interior sockets.

Table 5-57: Interior Socket Saturation by Room Type by EDC

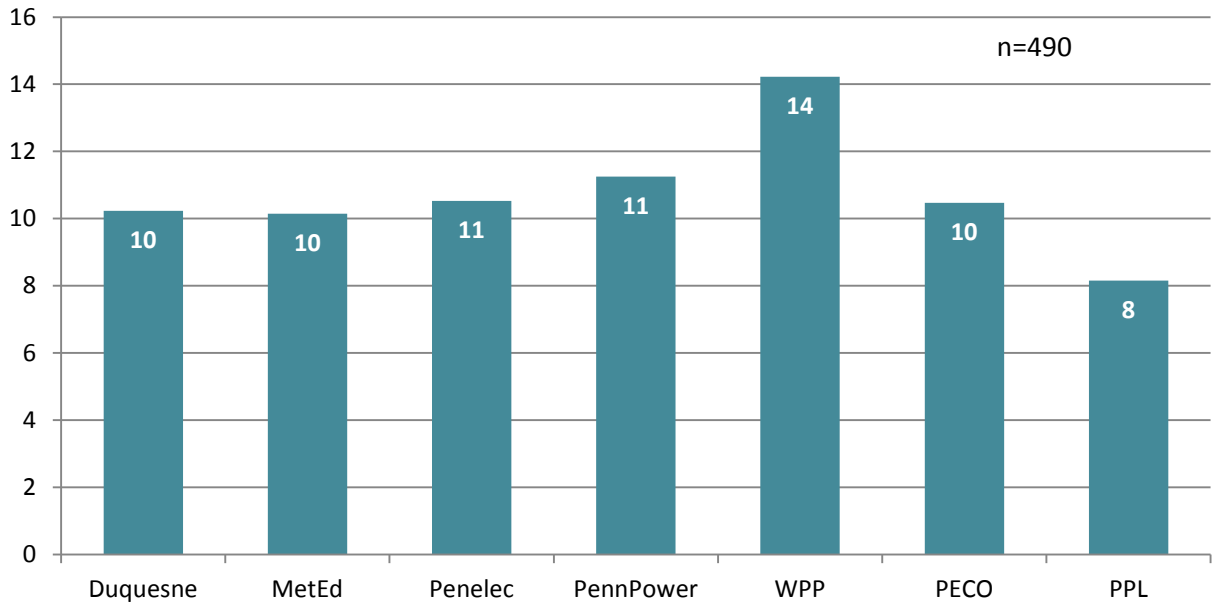
Bulb Type (Saturation)	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Bathroom	16%	14%	14%	14%	15%	16%	15%
Bedroom	17%	18%	19%	16%	16%	18%	15%
Closet	3%	4%	2%	3%	3%	3%	4%
Dining Room	8%	8%	6%	9%	7%	8%	7%
Foyer/Hallway	8%	8%	8%	9%	10%	11%	9%
Garage	5%	5%	5%	5%	6%	3%	4%

Bulb Type (Saturation)	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Kitchen	11%	10%	12%	10%	11%	13%	13%
Living Room	11%	11%	16%	12%	11%	11%	10%
Media/Bonus Room	1%	4%	2%	5%	5%	1%	1%
Office/Den	4%	5%	4%	3%	2%	5%	5%
Other	1%	2%	1%	2%	1%	2%	3%
Unfinished Basement/Attic	12%	9%	11%	7%	11%	8%	11%
Utility Room	3%	3%	2%	3%	2%	2%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	3211	3845	2905	4228	3859	3089	3824

5.5.5 Bulbs in Storage

Average Number of Bulbs in Storage. Across the EDCs, the average number of bulbs that homeowners held in storage ranged from 8 to 14 bulbs. PPL averaged 8 bulbs in storage per household while West Penn Power averaged 14 bulbs in storage per household. The remaining EDCs averaged 10-11 bulbs in storage per household.

Figure 5-14: Average Number of Bulbs in Storage by EDC



Bulbs in Storage by Quantity Bin. 61%-69% of homes had held less than 10 bulbs in storage across the EDCs, and 78%-89(% of homes held less than 20 bulbs. In contrast, only 5% or less had 50 or more bulbs in storage across the EDCs at the time on the on-site surveys.

Table 5-58: Quantity Range of Bulbs in Storage by EDC

Bulb Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-9 bulbs	61%	65%	67%	66%	62%	67%	69%
10-19 bulbs	17%	23%	20%	13%	16%	15%	19%
20-29 bulbs	11%	6%	5%	12%	10%	8%	5%
30-39 bulbs	7%	3%	3%	4%	6%	5%	3%
40-49 bulbs	4%	1%	2%	1%	2%	0%	0%
50+ bulbs	0%	3%	3%	3%	5%	6%	3%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	3211	3845	2905	4228	3859	3089	3824

Storage bulbs by Bulb Type. The majority of bulbs in storage were found to be incandescent bulbs, (59%-74% across the EDCs). 19%-35% of bulbs in storage were CFL bulbs, and less than two percent were LED bulbs. Few storage bulbs were halogens, modified halogens, or tube fluorescent lights.

Table 5-59: Type of Bulbs in Storage by EDC

Bulb Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Incandescent	59%	67%	62%	66%	61%	74%	67%
CFL	35%	30%	31%	28%	35%	19%	29%
LED	1%	0%	2%	0%	0%	0%	0%
Halogen	3%	1%	3%	4%	2%	3%	2%
Modified Halogen	2%	1%	0%	1%	0%	1%	0%
Tube Fluorescent	1%	1%	1%	0%	2%	2%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	3211	3845	2905	4228	3859	3089	3824

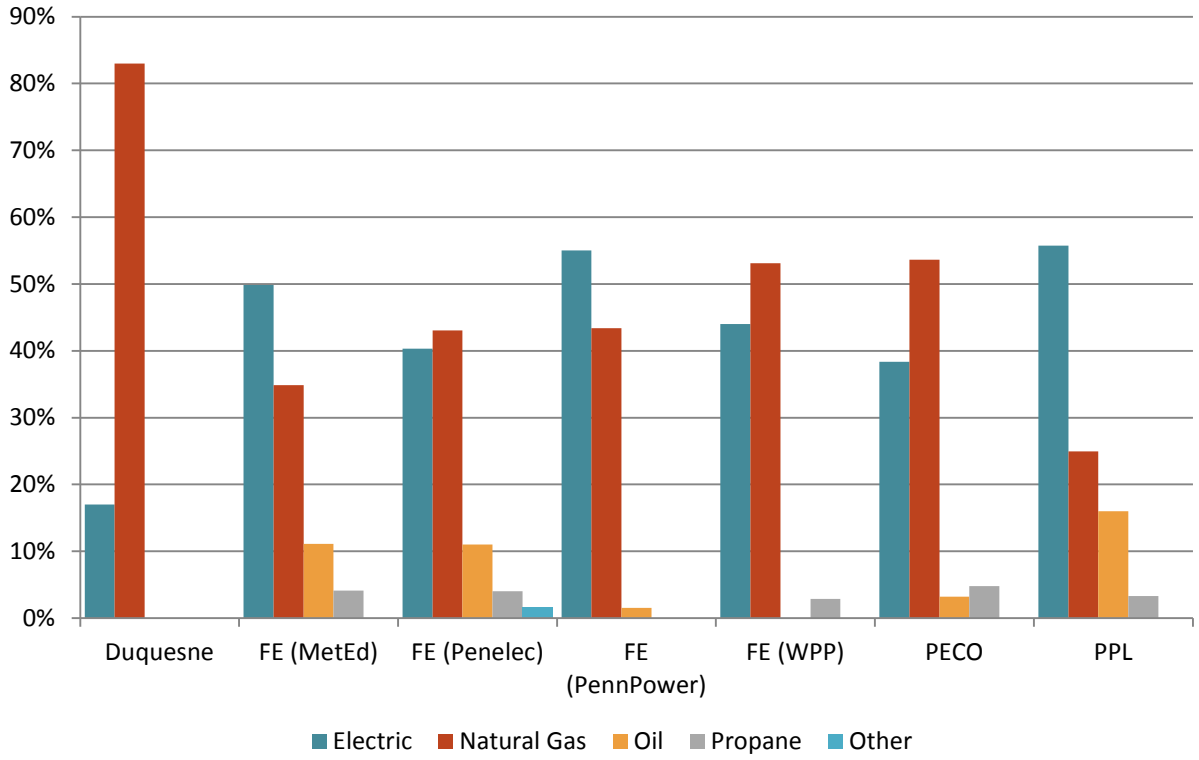
5.6 DOMESTIC WATER HEATING

This section presents details on the water heating equipment present in the surveyed homes.

5.6.1 Equipment Saturations by Fuel/Type

Water Heating Fuel Type. Of the homes surveyed 17% of homes in the Duquesne service area use electricity to heat their water. In the remaining EDCs the percent of homes that use electricity for water heating ranges from 38% to 56%. Met Ed, PPL and Penn Power all had electric water heating saturations 50% or greater. Natural gas is also prevalent for water heating purposes. Oil water heating is found in nearly 16% of homes in the PPL area, but is otherwise relatively uncommon.

Figure 5-15: Water Heating Fuel Type by EDC



Water Heating System Type. Of electric water heaters, the large majority (95%-100%) are traditional storage tank water heaters. Note that the number of observations is limited only to those surveyed residences with electric water heating.

Table 5-60: Electric Water System Type by EDC

Electric WH Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Heat Pump WH	0%	5%	0%	0%	0%	0%	0%
Stand Alone Tank	100%	95%	100%	100%	96%	100%	100%
On Demand	0%	0%	0%	0%	4%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	12	39	27	40	32	28	38

Water Heating Age. The average electric water heater age by EDC ranges from 6 years to 11 years.

Table 5-61: Electric Water Heater Age by EDC

Avg. Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Years	6	8	6	11	9	8	9
n	8	36	25	40	30	24	32

The table below presents the age range of electric water heating systems surveyed across the EDCs. With the exception of Duquesne, approximately one-third to one-half the electric water heaters are 10 years of age or older.

Table 5-62: Electric Water Heater Age Range by EDC

Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	25%	36%	50%	24%	29%	24%	44%
5-9 Years	62%	33%	16%	30%	20%	30%	19%
10-14 Years	0%	14%	30%	25%	21%	32%	19%
15-19 Years	13%	5%	0%	8%	21%	14%	7%
20 Years or Older	0%	11%	4%	13%	8%	0%	11%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	12	39	27	40	32	28	38

Tank Temperature. Water heater tank temperature was determined either by the tank temperature set point (when available), or the temperature of hot water from the nearest faucet to the storage tank The average electric water heater tank temperature set point ranges from 115°F to 124°F.

Table 5-63: Electric Water Heater Tank Temperature by EDC

Avg. Temp	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Degrees F	121	121	119	124	115	122	117
n	10	38	27	37	32	26	37

Tank Capacity. The average electric water heater tank capacity ranged from 41 gallons to 55 gallons across the seven EDCs.

Table 5-64: Electric Water Heater Tank Temperature by EDC

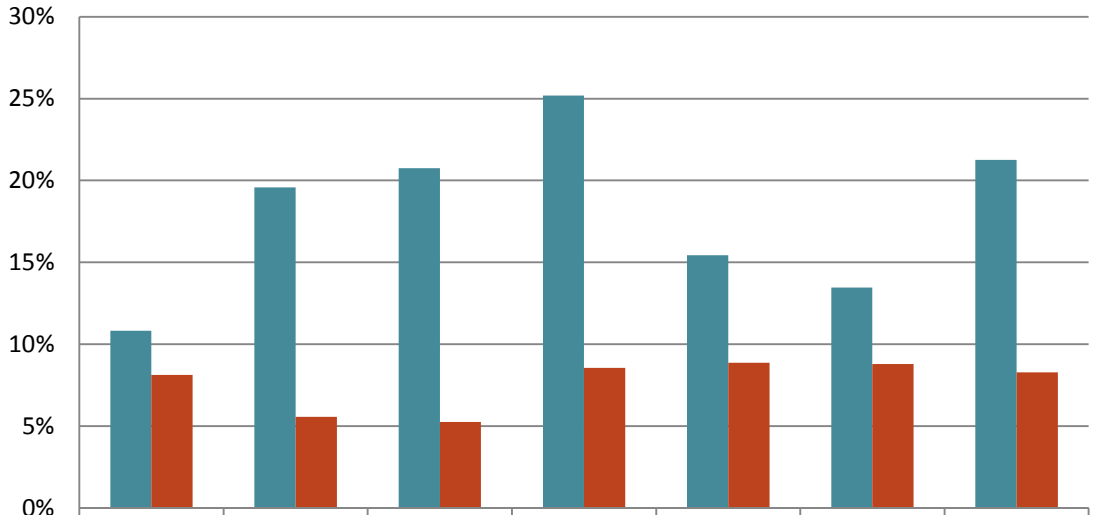
Avg. Tank Size	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Gallons	41	49	47	55	48	43	51
n	11	38	27	40	31	24	37

5.6.2 Water Heater Accessories

Pipe Wrap. Between 11% and 25% of water heaters surveyed were found to have pipe wrap located on pipes near the water heater.

Water Heater Blanket. Tank wrap was found on 5% to 9% of water heating units surveyed across the EDCs.

Figure 5-16: Water Heater Blanket & Tank Wrap by EDC



	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
Pipe Wrap	11%	20%	21%	25%	15%	13%	21%
Tank Wrap	8%	6%	5%	9%	9%	9%	8%

	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n (Pipe Wrap)	62	71	58	68	67	61	60
n (Tank Wrap)	62	72	56	69	67	59	60

5.6.3 Water Efficiency Measures

Water efficiency measures aid in energy conservation by reducing hot water usage, and subsequently reducing the overall energy needed for water heating. The most typical water efficiency measures are low-flow showerheads and faucet aerators.

Faucet Aerators. On average, homes have between 3.1 and 3.9 sinks. As indicated by the saturations, homes average between 0.5 and 2.1 faucet aerators. This range of low flow faucet aerators as a % of total sinks is 16%-58% across the EDC.

Table 5-65: Sinks and Faucet Aerators by EDC

Faucet Aerators	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Avg. # of Faucets	3.4	3.7	3.1	3.9	3.8	3.6	3.3
Avg. # Low Flow	0.7	0.9	1.0	1.8	1.1	2.1	0.5
% Low Flow	21%	26%	32%	45%	30%	58%	16%
n	70	70	70	70	70	70	70

Showerheads. On average, homes have between 1.4 and 1.7 showerheads per home. Low flow showerheads (<2.0 gal/minute) were found on 20% to 60% of all showerheads.

Table 5-66: Showers and Low Flow Showerheads by EDC

Showerheads	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Avg. # of Showerheads	1.4	1.7	1.4	1.7	1.7	1.6	1.6
Avg. # Low Flow	0.3	0.3	0.4	0.5	0.5	0.9	0.3
% Low Flow	20%	20%	26%	31%	32%	60%	21%
n	70	70	70	70	70	70	70

5.7 OTHER APPLIANCES/EQUIPMENT

This section presents details on the major appliances and other smaller consumer electronics found in the surveyed residences.

5.7.1 Refrigerators/Freezers

Number of Refrigerators. Nearly every surveyed home had at least one refrigerator. Most surveyed homes (55%-78%) have only one refrigerator, and between 19%-38% have two refrigerators. Only a small number of surveyed homes (11% or less) have three or more refrigerators.

Table 5-67: Number of Refrigerators by EDC

#	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0	0%	0%	0%	0%	0%	2%	0%
1	78%	65%	77%	70%	55%	64%	69%
2	19%	24%	20%	28%	38%	30%	27%
3	3%	11%	3%	1%	3%	5%	2%
4	0%	0%	0%	0%	3%	1%	2%
5	0%	0%	0%	1%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

Refrigerator Type. The most common type of refrigerator is the top-mount freezer across all seven EDCs, followed by side-by-side models, and bottom-mounted freezers. Compact refrigerators typically consist of 14% or less of all refrigerators found in homes.

Table 5-68: Refrigerator Type by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Bottom Freezer	11%	12%	10%	12%	10%	13%	16%
Compact	3%	9%	8%	9%	6%	14%	14%
Side by Side	19%	33%	22%	26%	31%	20%	24%
Top Freezer	66%	46%	59%	53%	53%	52%	46%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	87	103	88	95	107	99	93

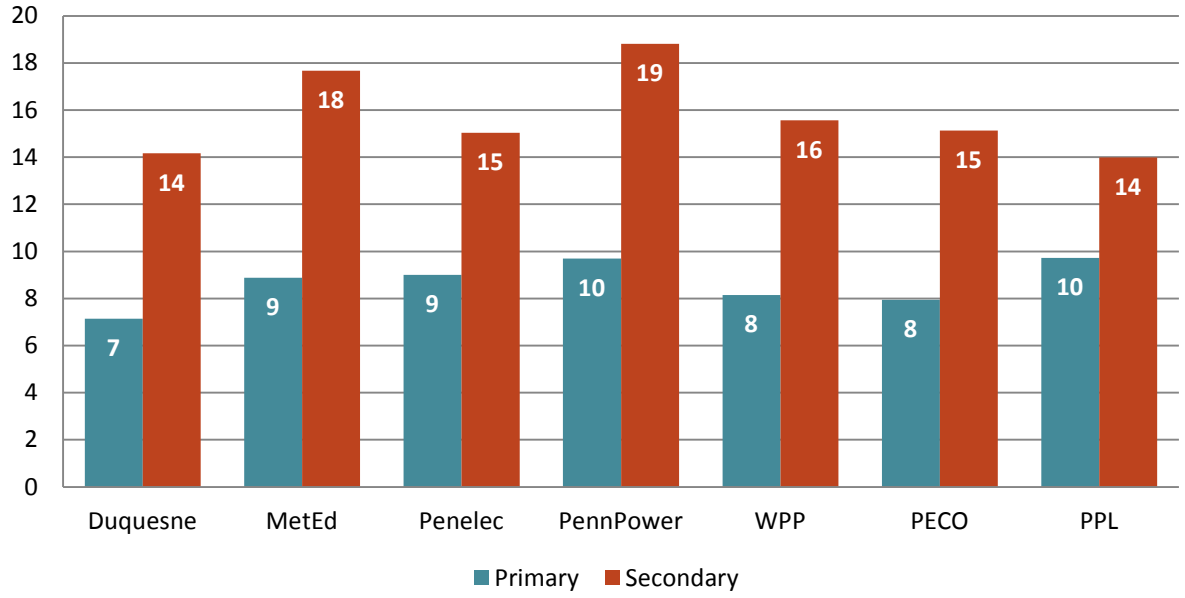
Refrigerator Size. The average refrigerator volume, excluding compact refrigerators, ranges from approximately 19.2 to 21.5 cu. ft.

Table 5-69: Average Refrigerator Volume by EDC

Avg. Volume	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Cubic feet	19.8	21.5	19.2	19.7	20.0	20.4	20.5
n	82	93	72	78	96	84	81

Refrigerator Age. The average primary refrigerator ranged from 7 to 10 years old across the seven EDCs. Second refrigerators were, on average, older than primary units.

Figure 5-17: Average Refrigerator Age by EDC



Avg. Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Primary (n)	62	67	64	64	66	66	65
Secondary (n)	12	21	11	15	25	14	5

The age distribution of primary refrigerators across the EDCs is shown in the table below.

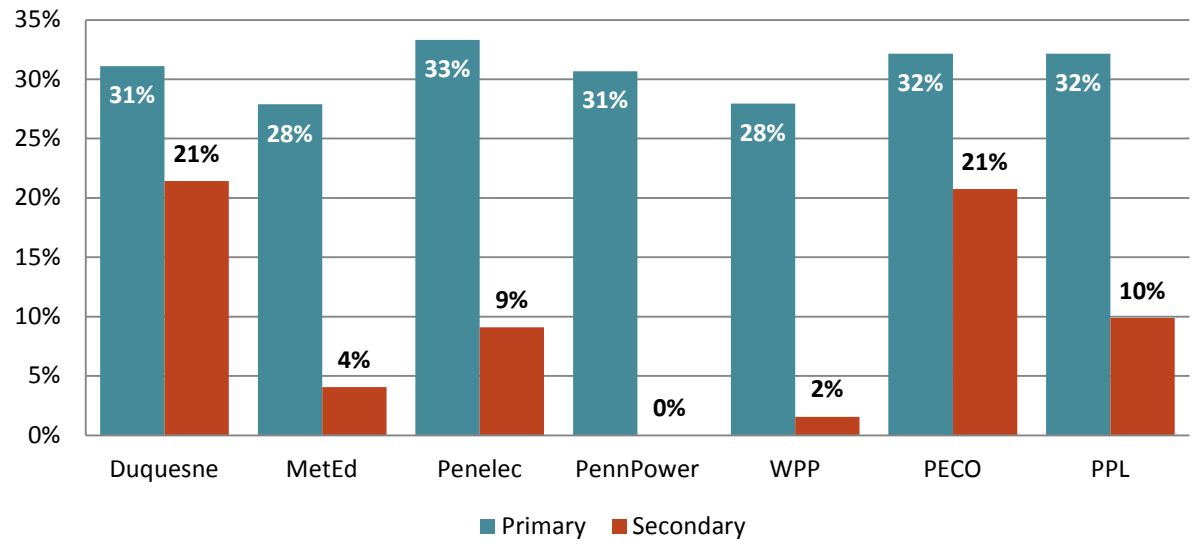
Table 5-70: Age Distribution of Primary Refrigerators by EDC

Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	35%	26%	30%	31%	38%	33%	31%
5-9 Years	33%	34%	22%	26%	28%	35%	31%
10-14 Years	25%	19%	32%	19%	18%	20%	21%
15-19 Years	3%	7%	8%	13%	8%	7%	5%
20 Years or Older	5%	13%	8%	10%	8%	5%	13%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	62	67	64	64	66	66	65

ENERGY STAR Refrigerators. On average, just shy of one-third of all primary refrigerators across the EDC currently possess the ENERGY STAR logo or are qualified as ENERGY STAR compliant. Where possible, the SWE team collected make/model information of refrigerators and verified ENERGY STAR status. For these EDCs, the percent of ENERGY STAR refrigerators ranged from 28-33%.

Secondary refrigerators, being typically older, were less likely to possess the ENERGY STAR logo. However, note the small sample size associated with secondary refrigerators.

Figure 5-18: ENERGY STAR Refrigerators by EDC



ENERGY STAR	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Primary (n)	70	70	69	70	70	70	70
Secondary (n)	14	24	12	17	31	15	11

Refrigerator Removal. During the on-site assessments, homeowners were asked if they had removed a refrigerator (primary or secondary) from their home over the last five years. If a refrigerator had been removed, homeowners were asked about the removal process. Across the EDCs, the majority of removed refrigerators were generally picked up by retailers followed by utility recycling.

Table 5-71: Refrigerator Removal Process by EDC

Refrig. Removal	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Donated	18%	9%	16%	24%	15%	5%	0%
I sold it	12%	5%	0%	5%	8%	0%	6%
Picked up by retailer	53%	49%	27%	42%	47%	59%	38%
Recycled by utility	12%	18%	22%	15%	15%	27%	37%
Trash	0%	14%	30%	10%	15%	0%	8%
Other	6%	5%	6%	5%	0%	8%	11%

Refrig. Removal	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	17	22	28	21	14	19	18

Across the EDCs, the majority of homes that removed a refrigerator over the last 5 years indicated that they replaced the removed refrigerator. The survey did not distinguish whether the removed refrigerator was the household's primary or secondary unit.

Table 5-72: Refrigerator Removal & Replacement by EDC

Refrig. Replaced	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
No	6%	13%	4%	19%	0%	0%	6%
Yes	94%	87%	96%	81%	100%	100%	94%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	17	22	28	21	14	20	18

Number of Freezers. The percent of homes with at least one freezer ranged from 24% in the Duquesne service area to 56% in the Penelec and PECO service areas. Generally less than 6% of homes have two or more stand-alone freezers.

Table 5-73: Number of Stand-Alone Freezers by EDC

#	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0	76%	59%	50%	57%	59%	71%	50%
1	23%	38%	45%	38%	35%	29%	47%
2	1%	3%	5%	3%	5%	0%	2%
3	0%	0%	0%	0%	2%	0%	2%
4	0%	0%	0%	1%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

Freezer Type. There is a substantial mix of upright and chest stand-alone freezers throughout all seven Pennsylvania EDCs.

Table 5-74: Stand-Alone Freezer Type by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Chest	61%	61%	43%	47%	56%	42%	39%
Upright	39%	39%	57%	53%	44%	58%	61%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	18	31	37	34	32	19	36

Freezer Age. The average freezer age ranged from 7 to nearly 16 years old across the seven EDCs.

Table 5-75: Stand-Alone Freezer Age by EDC

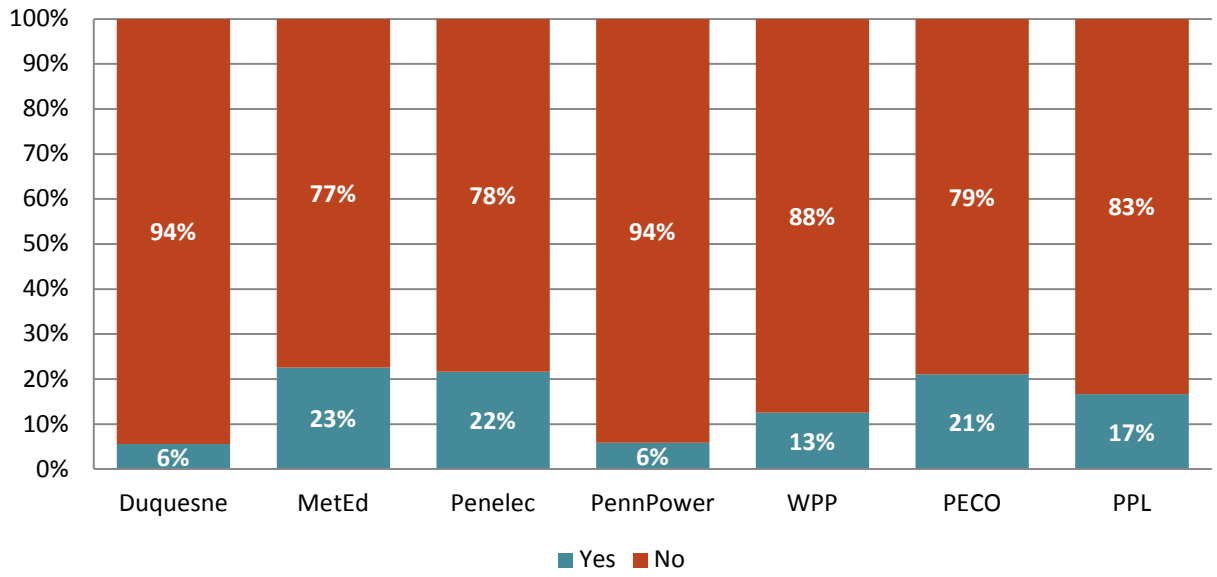
Avg. Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Years	7	12	15	9	13	16	10
n	15	31	34	31	29	18	33

Table 5-76: Age Distribution of Stand-Alone Freezers by EDC

Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	27%	35%	24%	32%	34%	17%	30%
5-9 Years	40%	19%	18%	32%	10%	11%	27%
10-14 Years	20%	6%	15%	10%	21%	28%	21%
15-19 Years	13%	13%	15%	6%	10%	0%	6%
20 Years or Older	0%	26%	29%	19%	24%	44%	15%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	15	31	34	31	29	18	33

ENERGY STAR Freezers. Where possible, the SWE team collected make/model information of freezers and verified ENERGY STAR status. For these EDCs, the percent of ENERGY STAR freezers ranged from 6% to 23%.

Figure 5-19: ENERGY STAR Stand-Alone Freezers by EDC



ENERGY STAR	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	18	31	37	34	32	19	36

5.7.2 Clothes Washers/Dryers

Number of Clothes Washers. The percent of homes with at least one clothes washer (penetration) ranged from 82% to 97% of residences. A small number of residences had more than one private clothes washer.

Table 5-77: Penetration/Saturation Clothes Washers by EDC

Clothes Washer	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Penetration	96%	88%	93%	97%	90%	82%	94%
Saturation	96%	91%	93%	97%	90%	84%	97%
n	70	70	70	70	70	70	70

Clothes Washer Type. The majority (61%-79%) of clothes washers surveyed were top-loading, as opposed to horizontal-axis machines.

Table 5-78: Top-Loading vs. Front-Loading Clothes Washers by EDC

Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Horizontal Axis	21%	23%	39%	30%	38%	28%	23%
Vertical Axis	79%	77%	61%	70%	62%	72%	77%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	58	63	62	62	61	50	66

Clothes Washer/Water Heating Type. The majority of clothes washers are supplied with either electric or natural gas water heating. The percent of clothes washers with electric water heating ranges from a low of 14% in the Duquesne service area to 58% in the Penn Power area.

Table 5-79: Clothes Washer/Water Heating Fuel Type by EDC

WH Fuel Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Electric	14%	49%	42%	58%	44%	41%	56%
Natural Gas	86%	34%	38%	40%	56%	49%	24%
Oil	0%	12%	12%	2%	0%	4%	16%
Propane	0%	5%	4%	0%	0%	6%	3%
Other	0%	0%	3%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	58	63	62	62	61	50	66

Clothes Washer Age. The average clothes washer ranged from 8 to 9 years old across the seven EDCs.

Table 5-80: Clothes Washer Age by EDC

Avg. Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Years	9	8	8	9	8	9	8
n	46	57	52	57	56	43	61

Table 5-81: Age Distribution of Clothes Washers by EDC

Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	31%	31%	34%	20%	35%	28%	31%
5-9 Years	29%	36%	29%	45%	35%	38%	33%
10-14 Years	19%	14%	24%	14%	15%	13%	17%
15-19 Years	13%	9%	6%	10%	10%	12%	12%
20 Years or Older	9%	11%	7%	11%	5%	8%	7%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	46	57	52	57	56	43	61

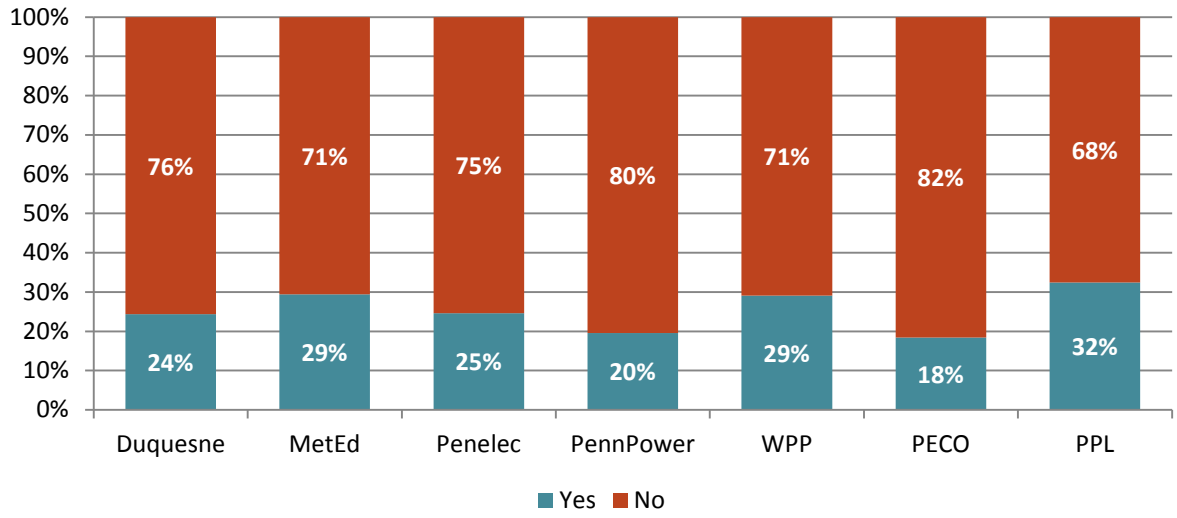
Loads per Week. The average household washes 4 to 5 loads per week.

Table 5-82: Clothes Washer Loads per Week by EDC

Avg. Use	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Loads/ Week	5	5	5	5	5	4	5
n	58	62	62	61	59	49	66

ENERGY STAR Clothes Washers. 18% - 32% of clothes washers were ENERGY STAR rated across the EDCs. The SWE team documentation of ENERGY STAR clothes washers was based on the ability to visually detect the label or determine that a particular model was ENERGY STAR rated by searching for the make and model number on the ENERGY STAR website or manufacturer data. It should be noted that there are likely occasions where a clothes washer was ENERGY STAR compliant at one time, but may have since lost its rating due to increased efficiency standards.

Figure 5-20: ENERGY STAR Clothes Washers by EDC



ENERGY STAR	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	58	63	62	62	61	50	66

Dryer Fuel Type. Electric dryers are more prevalent on average than natural gas dryers. As expected, dryers that use bottle fuels are rare.

Table 5-83: Dryer Fuel Type by EDC

WH Fuel Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Electric	60%	90%	70%	84%	77%	65%	87%
Natural Gas	40%	10%	28%	16%	22%	31%	11%
Propane	0%	0%	2%	0%	2%	4%	2%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	61	59	62	64	62	53	65

The table below provides even further disaggregation to show the clothes washer water heater fuel type and dryer fuel type combination across seven EDCs Non-electric dryers are far more common in homes with clothes washers equipped with non-electric water heating than clothes washers with electric water heaters.

Table 5-84: Clothes Washer Water Heater / Dryer Fuel Type Combo by EDC

Fuel Type Combo	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Clothes Washers with Electric WH & Dryer Fuel Type Combo							
Electric	10%	44%	37%	52%	42%	37%	49%
Non-Electric	4%	2%	5%	4%	2%	2%	5%
No Dryer	0%	3%	0%	2%	0%	2%	2%
Clothes Washers with Non-Electric WH & Dryer Fuel Type Combo							
Electric	48%	42%	33%	30%	34%	24%	35%
Non-Electric	33%	8%	22%	10%	22%	33%	9%
No Dryer	5%	2%	3%	2%	0%	2%	0%
n	58	63	62	62	61	50	66

5.7.3 Dishwashers

Number of Dishwashers. 55% to 75% of homes surveyed contained a dishwasher, with a negligible number of homes having more than one.

Table 5-85: Dishwasher Penetration by EDC

Dishwasher	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Penetration	69%	66%	55%	72%	70%	61%	75%
n	70	70	70	70	70	70	70

Dishwasher/Water Heating Type. The percent of dishwashers with electric water heating ranges from a low of 15% in the Duquesne service area to 58% in the PPL area.

Table 5-86: Dishwasher/Water Heating Type by EDC

WH Fuel Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Electric	15%	49%	37%	49%	46%	43%	58%
Natural Gas	85%	37%	42%	49%	54%	48%	25%
Oil	0%	8%	13%	2%	0%	2%	13%
Propane	0%	6%	5%	0%	0%	7%	4%
Other	0%	0%	3%	0%	0%	0%	0%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	47	49	38	51	48	42	52

Dishwasher Age. The average dishwasher age ranged from 8 to 13 years among surveyed residences.

Table 5-87: Dishwasher Age by EDC

Avg. Age	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Years	8	10	13	9	8	8	9
n	39	46	33	48	47	37	45

Table 5-88: Age Distribution of Dishwashers by EDC

Age Range	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0-4 Years	33%	15%	12%	35%	34%	24%	36%
5-9 Years	33%	39%	27%	21%	32%	40%	29%
10-14 Years	15%	20%	24%	27%	19%	27%	20%
15-19 Years	5%	13%	18%	10%	11%	5%	2%
20 Years or Older	13%	13%	18%	6%	4%	3%	13%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	39	46	33	48	47	37	45

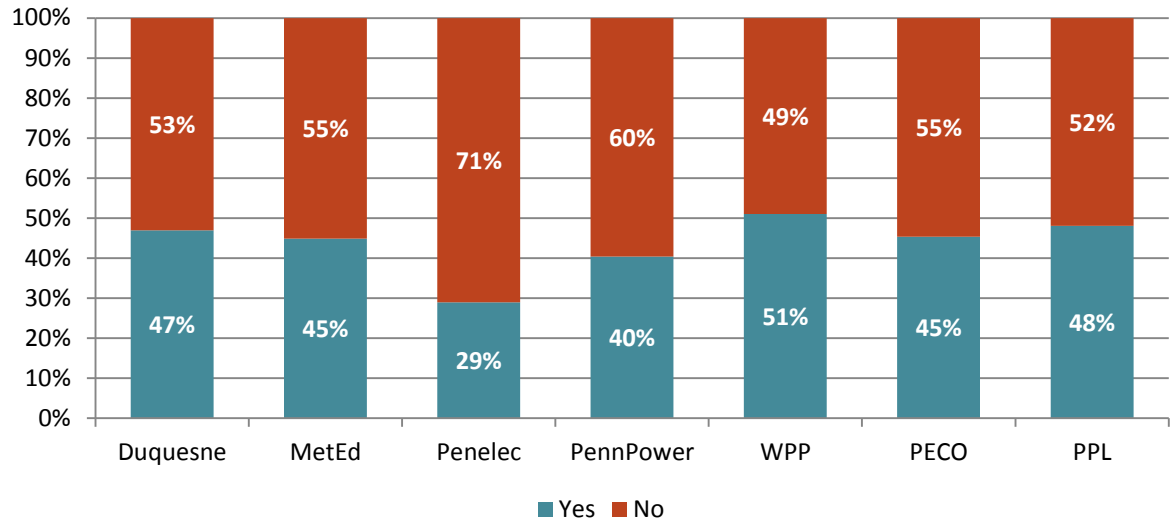
Loads per Week. The average household washes 2 to 4 loads per week.

Table 5-89: Dishwasher Washer Loads per Week by EDC

Avg. Use	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Loads/ Week	3	2	2	3	4	2	3
n	49	48	38	52	49	42	52

ENERGY STAR Dishwashers. 29% - 51% of dishwashers were ENERGY STAR rated across the EDCs. Where possible, the SWE team collected make/model information of dishwashers and verified ENERGY STAR status.

Figure 5-21: ENERGY STAR Dishwashers by EDC



ENERGY STAR	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	49	49	38	52	49	42	52

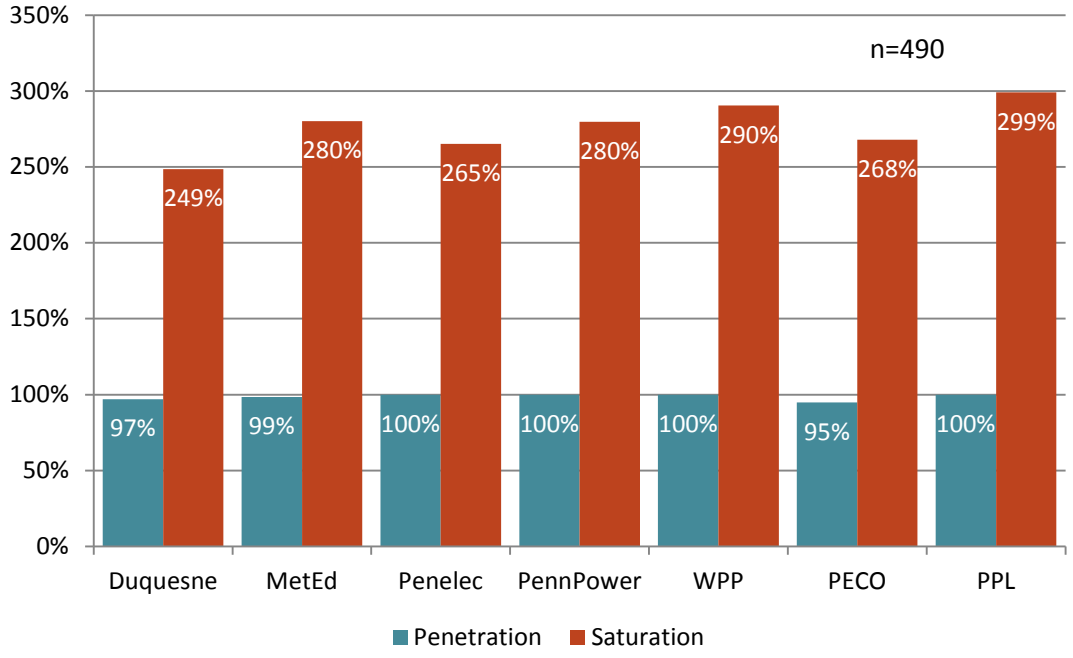
5.7.4 Consumer Electronics

Number of Televisions. Nearly every residence surveyed had at least one television. On average, residences had between 2.5 and 3.0 televisions per household across the seven EDCs.

Table 5-90: Penetration/Saturation of Televisions by EDC

# of TVs	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
0	3%	1%	0%	0%	0%	5%	0%
1	15%	16%	18%	15%	19%	17%	9%
2	40%	33%	38%	30%	21%	29%	39%
3	27%	27%	20%	30%	25%	24%	23%
4	7%	11%	10%	18%	27%	12%	15%
5+	9%	11%	13%	7%	8%	12%	14%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	70	70	70	70	70	70	70

Figure 5-22: Penetration/Saturation of Televisions by EDC



	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	70	70	70	70	70	70	70

Television Type/Size. Approximately 26%-35% of televisions were currently estimated to have a screen-size of larger than 40 inches. When focusing on flat screen televisions (LED, LCD, and Plasma TVs), 42%-53% of televisions are 40 inches or greater.

Table 5-91: Screen Size of Televisions by EDC

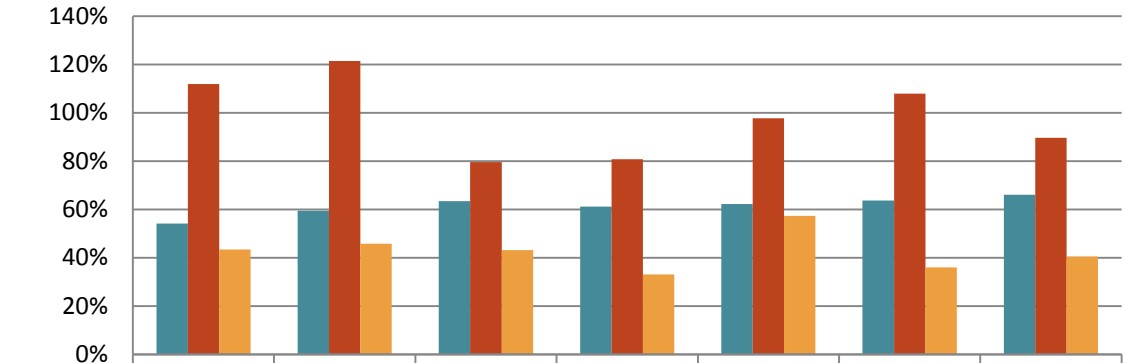
Screen Size	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
< 20"	15%	18%	21%	11%	24%	18%	23%
20"-29"	29%	25%	20%	30%	19%	31%	25%
30"-39"	22%	27%	28%	28%	22%	22%	26%
40"-49"	24%	21%	21%	20%	20%	18%	19%
50"-59"	7%	7%	5%	9%	12%	10%	6%
60" & up	2%	2%	5%	2%	3%	1%	1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	175	196	186	197	201	183	206

Table 5-92: Screen Size of Flat Screen Televisions by EDC

Screen Size	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
< 20"	6%	5%	11%	10%	14%	13%	16%
20"-29"	21%	18%	5%	11%	8%	12%	11%
30"-39"	27%	31%	36%	34%	26%	32%	31%
40"-49"	34%	33%	34%	30%	32%	27%	31%
50"-59"	9%	9%	7%	13%	19%	14%	10%
60" & up	3%	3%	7%	2%	3%	2%	1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
n	111	118	105	124	123	107	123

Number of Desktop/Laptop/Tablet Computers. Laptop PC saturations are higher across all seven EDCs than Desktop and Tablet PCs. The saturation of laptops ranges from 80% to 121%. In 2013, Desktop PCs are the second more frequent PC, followed by Tablet PCs.

Figure 5-23: Saturation of Desktop, Laptop, and Tablet PCs by EDC



	Duquesne	MetEd	Penelec	PennPower	WPP	PECO	PPL
Desktop	54%	59%	63%	61%	62%	64%	66%
Laptops	112%	121%	80%	81%	98%	108%	90%
Tablets	43%	46%	43%	33%	57%	36%	41%

	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
n	70	70	70	70	70	70	70

PC Monitor Type. Twenty-four percent or less of PC Monitors surveyed were equipped with CRT Monitors. The majority of computers utilize LCD flat screen monitors.

Table 5-93: PC Monitor Type by EDC

PC Monitors	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
CRT	11%	5%	24%	16%	7%	6%	11%
Flat Screen	89%	95%	76%	84%	93%	94%	89%
n	29	36	38	39	35	36	41

Power strips. The percentage of television units and desktop/laptop PCs with power strip units is presented in the table below. The majority of televisions and PCs plug into power strips rather than directly into wall sockets. Across the EDCs, less than 7% of televisions and 5% of PC units were identified as plugged into advanced, energy-savings, power strips.

Table 5-94: Power Strip Type by EDC

Power Strips	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Television Units							
Basic Power Strip	66%	45%	52%	51%	50%	57%	58%
No Strip	31%	49%	44%	47%	44%	43%	38%
Smart Strip	3%	7%	4%	2%	6%	0%	4%
n	174	195	185	197	201	182	206
Desktop/Laptop PC							
Basic Power Strip	54%	52%	58%	41%	51%	54%	66%
No Strip	40%	44%	39%	54%	46%	42%	32%
Smart Strip	5%	4%	3%	5%	3%	4%	2%
n	77	79	73	82	80	84	80

Additionally, of homes with power strips (Basic & Advanced Smart Strips), the average number of peripheral devices associated with television and PC units across all EDCs is two. These peripherals are in addition to the power source for the television and PC units.

Table 5-95: Average Number of Peripheral TV & PC Devices by EDC

Avg. # of Peripherals	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Television Units							
Average #	2.3	2.0	2.0	2.5	2.4	1.8	2.0
n	120	101	103	106	113	103	131
Desktop/Laptop PC							
Average #	2.2	2.0	1.5	2.2	2.4	2.2	2.1
n	46	45	45	38	43	48	55

Miscellaneous Consumer Electronics. The penetration and saturation data for various small consumer electronics collected by the SWE team are presented below.

Of the surveyed equipment, fax machines and home Ttheater systems units are the least common items in the surveyed households. Gaming systems are present in slightly more than 50% of homes; stereo systems are present in roughly two-thirds of households. On average, households have at least one DVD player and phone charger.

Table 5-96: Penetration/Saturation of Miscellaneous Electronics by EDC

Misc. Electronics	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
DVD							
Penetration	81%	81%	81%	89%	87%	86%	86%
Saturation	115%	135%	109%	141%	120%	121%	111%
Fax Machine							
Penetration	23%	30%	30%	32%	28%	29%	45%
Saturation	24%	41%	35%	32%	31%	32%	51%
Gaming							
Penetration	36%	32%	44%	42%	44%	41%	43%
Saturation	56%	54%	59%	52%	70%	56%	68%
Home Theater							
Penetration	25%	22%	22%	21%	34%	16%	28%
Saturation	28%	23%	25%	22%	34%	16%	29%
Phone Charger							
Penetration	94%	93%	92%	90%	89%	93%	96%
Saturation	198%	219%	171%	185%	189%	203%	196%
Stereo							
Penetration	51%	62%	51%	61%	42%	55%	49%
Saturation	57%	94%	61%	85%	60%	72%	64%
VCR							
Penetration	41%	49%	53%	59%	32%	46%	42%
Saturation	45%	59%	73%	80%	32%	57%	46%
n	69	69	69	69	69	70	70

5.7.5 Other Equipment

Humidifiers. At least one humidifier was present in only 3% to 17% of surveyed homes across the seven EDCs. The saturation of humidifiers across the seven EDCs ranges from 4% - 20%.

Dehumidifiers. At least one dehumidifier was present in 26%-46% of surveyed homes. After accounting for homes with multiple dehumidifiers, the saturation is estimated to range from 27% to 57% across the EDCs.

Table 5-97: Humidifier/Dehumidifiers Saturation by EDC

	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Humidifiers							
Penetration	3%	10%	17%	12%	15%	12%	10%
Saturation	4%	11%	20%	12%	17%	15%	10%
n	70	70	70	70	70	70	70
Dehumidifiers							
Penetration	33%	36%	35%	45%	42%	26%	46%
Saturation	33%	57%	43%	45%	50%	27%	54%
n	70	70	70	70	70	70	70

Humidifiers/Dehumidifier Usage. On average, dehumidifiers run between 5 and 8 months per year. Similarly, humidifiers run less, an average of 3 to 7 months per year.

Table 5-98: Humidifier/Dehumidifier Use (Months/Year) by EDC

Avg. Use	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Humidifiers							
Months	6	3	3	5	5	4	7
n	2	7	11	8	10	8	7
Dehumidifiers							
Months	6	7	5	7	8	8	8
n	23	26	24	31	29	17	29

Ceiling Fans. More than two-thirds of homes have at least one ceiling fan. Of the surveyed homes, the average number of ceiling fans in all homes ranges from 1.9 to 2.4.

Oscillating Fans. More than half of homes have at least one oscillating fan across all seven EDCs. Of the surveyed homes, the average number of oscillating fans in all homes ranges from 0.9 to 1.6.

Table 5-99: Penetration/Saturation of Ceiling Fans by EDC

	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Ceiling Fans							
Penetration	82%	71%	76%	86%	78%	67%	82%
Saturation	197%	231%	237%	244%	245%	187%	242%
n	70	70	70	70	70	70	70
Oscillating Fans							
Penetration	69%	72%	72%	58%	61%	72%	64%
Saturation	126%	128%	137%	92%	119%	157%	112%
n	70	70	70	70	70	70	70

Fan Usage. In general, less than 45% of all fans are used more than 6 hours per day during the cooling season.

Table 5-100: Ceiling Fan Hours of Use by EDC

6+ Hrs/Day	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Ceilings Fans							
Yes	20%	31%	19%	25%	13%	44%	40%
n	58	50	53	59	53	45	57
Oscillating Fans							
Yes	29%	38%	21%	28%	26%	43%	41%
n	48	50	51	41	42	50	44

Pools & Hot Tubs. The vast majority of homes do not have any outdoor recreational equipment such as a swimming pool or hot tubs. In general less than 10% of homes in any EDC have a private swimming pool. Similarly, 89%-99% of homes surveyed or more do not have a hot tub or spa across the EDCs.

Table 5-101: Pool/Spa Saturation by EDC

Pool Type	Duquesne	MetEd	Penelec	Penn Power	WPP	PECO	PPL
Above Ground	3%	1%	6%	6%	5%	3%	3%
In Ground	1%	1%	0%	1%	3%	2%	7%
Hot Tub/Spa	1%	3%	5%	5%	3%	2%	11%
n	70	70	70	70	70	70	70

6 WILLINGNESS TO PAY RESEARCH

As part of its baseline study of residential sector, the SWE team conducted a willingness-to-pay (WTP) exercise during the in-home surveys with home energy decision makers. This section of the report describes the details of this exercise and its associated findings; details regarding the overall baseline study (e.g., sampling, recruiting, other survey details) are described elsewhere. Although findings from this exercise are presented in this report, these findings will be used as inputs in the follow-up market potential study of residential customers.

Willingness-to-pay survey exercises are examples of a social science methodology commonly referred to as contingent valuation and are intended to measure a survey respondent's stated intention to purchase a product (or service) when presented with a series of alternative scenarios usually involving the manipulation of the price (or cost) of the product (or service). The results of these studies, when aggregated, are frequently used to gauge the relative demand (e.g., purchase likelihood) for a product (or service) and ultimately help determine the selling price for a product (or service). It is important to note that these exercises ask respondents direct questions that require them to estimate their purchase likelihood when presented with a hypothetical future purchase scenario. Although there are other approaches to conducting pricing research, such as analyzing product sales at different prices in different markets, these approaches were not feasible given the time and budget constraints of the residential baseline study.

The objective of the residential baseline study's willingness-to-pay exercise was to gauge the relative purchase likelihood among residential customers for six common residential energy efficiency measures under a series of pricing scenarios designed to mimic the incentives of a hypothetical consumer-focused energy efficiency program.

6.1 INTERPRETING WILLINGNESS-TO-PAY FINDINGS

In combination with other market data, the results of this willingness-to-pay research can inform several aspects of program planning:

- Program measure selection: Results can facilitate comparing the effects of incentive dollars on estimated purchase likelihoods across products.
- External barriers to product installation: The proportion of respondents reporting lower purchase likelihoods with incentives covering 100% of the incremental cost can indicate that non-financial barriers to efficient product installation must be addressed.
- Incentive levels: By examining purchase likelihood at several levels of incentives, WTP results can provide inputs for setting incentive levels to maximize the impact of the incentive on customer purchase decisions.
- Free-ridership: WTP results can help mitigate free-ridership risk through providing an estimate of the likelihood of efficient product purchase without incentives.

6.2 KEY TAKEAWAYS

Consistent with their lower incremental cost and relatively mature technology status, respondents reported the highest likelihood to purchase efficient refrigerators and CFLs without incentives, but incentives that covered a portion of the incremental cost for these two measures had a correspondingly lower influence on respondents' willingness to pay than for other measures. Furthermore, the relative effect of an increased incentive on purchase likelihood diminishes above 50% of incremental cost.

Increasing incentives had the most effect on purchase likelihood for LEDs, central air conditioning, and insulation. Incentives that covered more than 50% of the incremental measure cost were associated with the highest increases in reported purchase likelihood; incentives below 50% had a relatively lower effect on willingness-to-pay for these efficient measures.

There may be non-financial barriers to insulation and CFL installation that need to be addressed for some respondents. A notable proportion of respondents (14% for CFLs, 22% for insulation) reported that they would be less than "extremely likely" to purchase the efficient product when 100% of the incremental cost was incented. For CFLs, participant responses could indicate a need for education to address ongoing concerns about light quality and compatibility with specialized lighting fixtures such as dimmable and special shapes. For insulation, in contrast with the other measures, survey questions were framed such that respondents were asked about purchasing additional insulation. So one possible interpretation is that customers may place a relatively low value on this measure, which is expected given that customers have a very low level of interaction with this product, and benefits are often not directly observable.

While there were some significant differences in responses across EDCs, no systematic patterns emerged. No significant differences were observed by home type.

6.3 WILLINGNESS-TO-PAY SURVEY METHODOLOGY

As noted, the willingness-to-pay exercise was included as part of the overall in-home baseline survey of residential customers. The exercise focused on six common energy efficiency measures covering appliances, lighting, HVAC systems, and the building envelope. The specific measures included in the exercise were:

- High-efficiency refrigerators
- LEDs
- CFLs
- High-efficiency air source heat pump system
- High-efficiency central air conditioning system
- Household attic insulation

Respondents that rented their homes were only asked the lighting-related questions, and home owners were only asked the HVAC-related questions if they currently owned a comparable heat pump or air conditioning system.

For each measure, a series of questions were asked to elicit the stated purchase likelihood of the measure under five alternative scenarios. The first scenario was purchasing the product without any

financial discount. Scenarios two through five involved offered the respondent a 25%, 50%, 75%, or 100% discount off the initial purchase price. The willingness-to-pay questions used an 11-point scale, where 0 meant 'not at all likely' and 10 meant 'extremely likely', and respondents were asked to indicate their likelihood of purchasing the product given each of the five scenarios. If a respondent indicated a likelihood of 10 in any of the first four price discount scenarios, they were skipped to the next set of questions for a different measure.

The framing of the questions was an important part of the exercise. Before each series of product-related questions, respondents were presented with the hypothetical scenario of purchasing a standard model or a high-efficiency version of the product. For the CFL- and LED-related questions, EISA-compliant halogen bulbs were used as the standard product. For all measures except attic insulation, respondents were presented with a purchase scenario that assumed purchasing the new product after their existing product (e.g., refrigerator, incandescent bulb, heat pump, etc.) had failed or stopped working. For attic insulation, respondents were presented with a purchase scenario that involved adding six inches of additional insulation.

Respondents were informed of the high-efficiency product's energy saving characteristics, longevity, and likely annual and lifetime electricity bill savings. The estimated energy and bill savings of the high-efficiency products were determined through a review of the Pennsylvania TRM. Under each scenario, respondents were presented with the selling price difference between the standard model and the high-efficiency model of the product. That is, respondents were presented with the additional cost in dollars needed to purchase the high-efficiency model.

6.4 DATA ANALYSIS

Following data collection, the survey responses were compiled by respondent and analyzed statewide, and then across the EDCs and four housing type categories. Three metrics were computed: 1) average purchase likelihood; 2) average purchase likelihood sensitivity; and 3) average incremental increase in purchase likelihood. Average purchase likelihood was computed using the responses to the 0-10 purchase likelihood questions. Likelihood sensitivity is a variation on the economic concept of elasticity and measures the percentage change in purchase likelihood relative to the percentage change in the price discount (incentive amount). It was calculated as the ratio of the change in purchase likelihood relative to the change in percent purchase discount —0% purchase discount vs. 100% purchase discount. Higher sensitivity values imply larger changes in purchase likelihood given a change in the purchase discount from 0% to 100%. Lastly, the incremental purchase likelihood measures the increase in purchase likelihood at each incremental incentive level (i.e., 0%, 25%, 50%, 75, and 100% discounts).

The overall baseline survey placed equal sampling emphasis on all seven EDCs, regardless of the incidence of the utilities' overall statewide proportions of residential customers, and 70 surveys were completed for each EDC. In the presentation of statewide results that follow, the appropriate sampling weights were applied to each survey response to adjust for differences in statewide proportions. The development of these weights is discussed in Section 3.3.2.

6.5 STATEWIDE FINDINGS

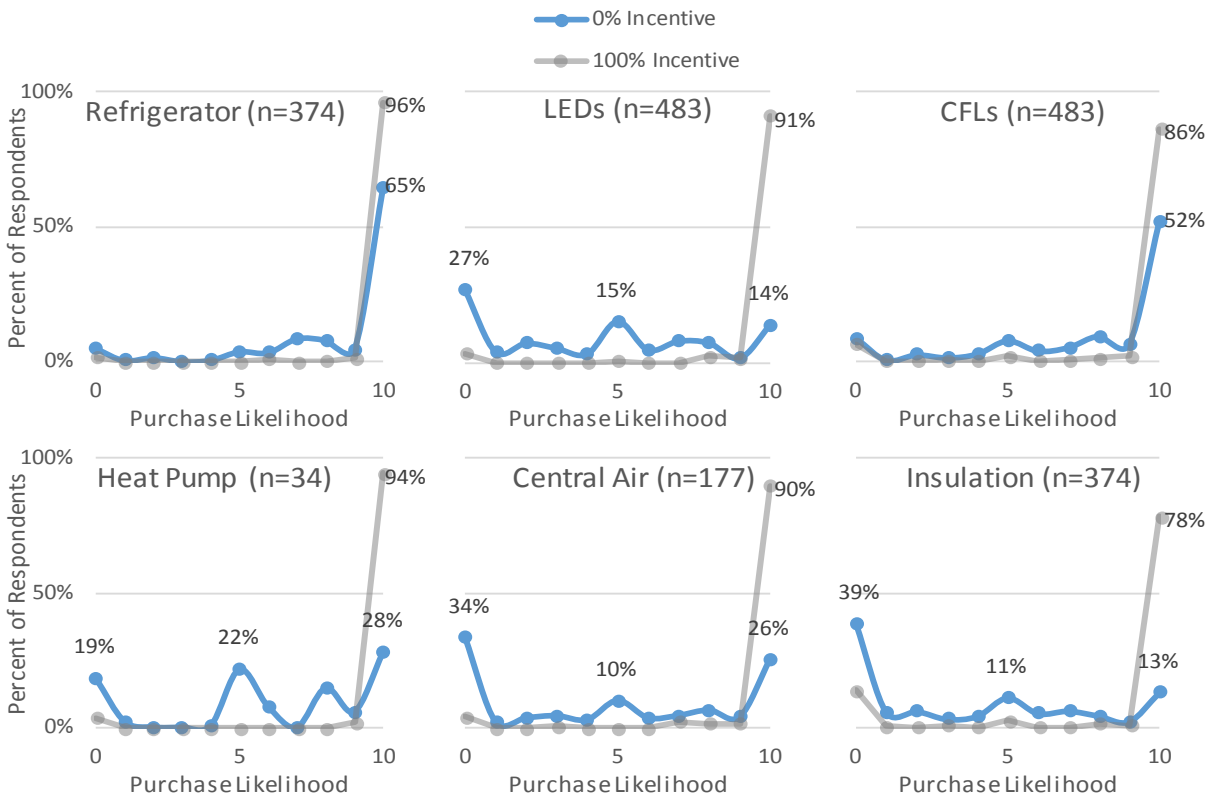
The SWE team performed five types of analyses on the statewide residential willingness-to-pay survey responses. These results are presented below.

6.5.1 Distribution of Likelihood Responses

Figure 6-1 shows the weighted distribution of respondents' purchase likelihood ratings for each product at 0% incentive (blue line) and 100% of the incremental cost incented (gray line). The distribution of reported purchase likelihood at 0% incentive differs by measure. For refrigerators and CFLs, a majority of contacts reported that they would be extremely likely to purchase the measure without an incentive.[26] For the remaining products, respondents' reported purchase likelihood without an incentive was distributed more evenly across the range of possible responses.

When the incentive covered 100% of the incremental cost of the measure, a majority of respondents rated their purchase likelihood "extremely likely" for all measures. The proportion of respondents who rated themselves less than "extremely likely" to purchase the measure at the 100% incremental cost incentive was highest for CFLs (14%) and insulation (22%).

Figure 6-1: Distribution of Purchase Likelihood Ratings by Measure and Incentive Level

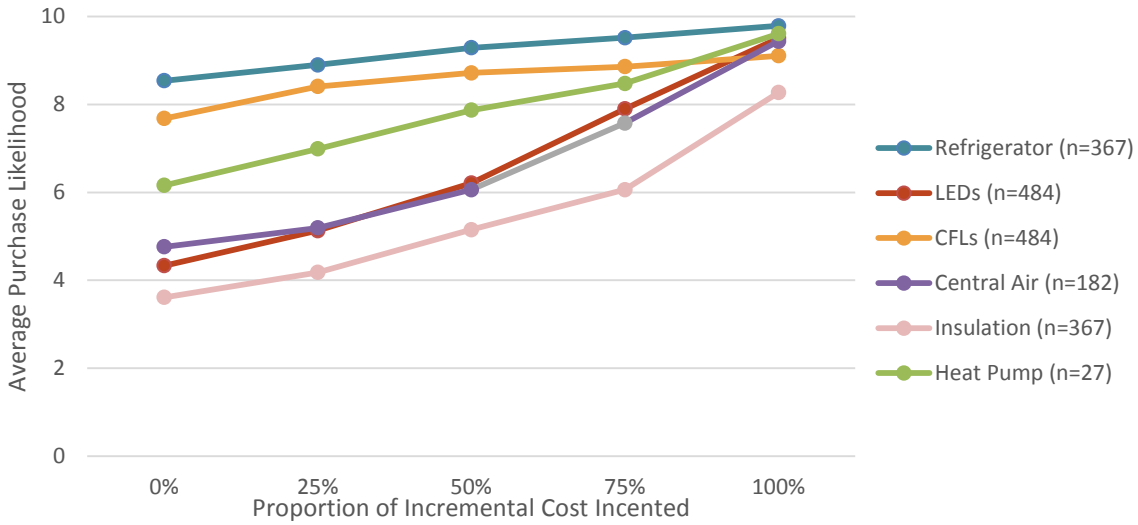


[26] Note that while the survey included information about incremental cost to inform respondents' likelihood ratings, statewide incentives on CFLs and LEDs have reduced the incremental cost of CFLs and LEDs in the market. The SWE team cannot say with certainty that these decreased incremental costs did not affect respondents' ratings for these products. See section 4.5 for additional analyses on CFLs.

6.5.2 Purchase Likelihood

Figure 6-2 displays respondents' average reported purchase likelihood at each offered incentive level (0%, 25%, 50%, 75, and 100% of the incremental measure cost) for each measure. High-efficiency refrigerators and CFLs had the average reported purchase likelihood without incentives, followed by heat pumps, central air conditioners, LEDs, and insulation.

Figure 6-2: Average Purchase Likelihood Ratings by Incentive Level



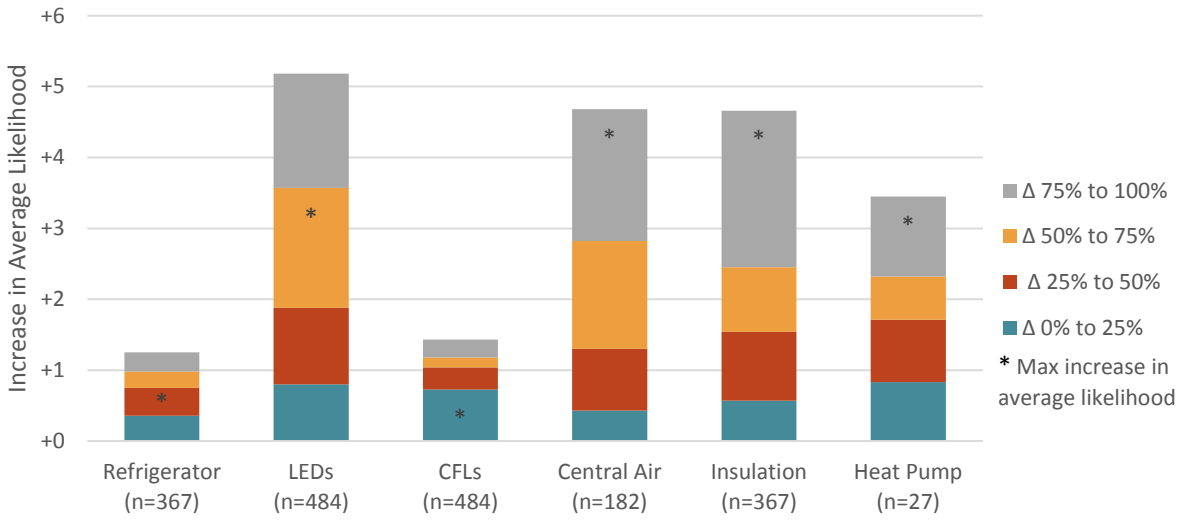
6.5.3 Incremental Likelihood

The SWE team also analyzed the changes in incremental purchase likelihood across each of the products. Incremental likelihood refers to the increase in average purchase likelihood from one incentive level to the next (for example, the increase in purchase likelihood without any incentive to an incentive covering 25% of incremental measure cost.) This incremental likelihood can be examined by comparing the slope of the line between each of the points in Figure 6-2, or the height of each colored bar in Figure 6-3. The overall height of the bars in Figure 6-3 shows the total change in respondents' reported purchase likelihood between no incentive and 100% incremental cost incented. Each color shows the incremental change in purchase likelihood at from one incentive level to the next. The asterisk highlights the maximum change in average likelihood for each measure.

For refrigerators and CFLs, the overall change in purchase likelihood was lower than for other products, and the incentive amount with the maximum change in purchase likelihood were lower than other products: for refrigerators, the maximum increase in purchase likelihood ratings occurred when the incentive increased from 25% of incremental cost to 50% of incremental cost, for CFLs, the maximum increase occurred between no incentive and 25% of incremental cost. For both measures, the increase in reported purchase likelihoods was small as incentives increased above those levels. For LEDs, the overall change in purchase likelihood was highest, and the maximum increase in purchase likelihood ratings occurred when the incentive increased from 50% of incremental cost to 75% of incremental cost. For central air, insulation, and heat pumps, the overall change in purchase likelihood was moderate to

high relative to the other measures, and the maximum increase in purchase likelihood ratings occurred when the incentive increased from 75% to 100% of incremental cost.

Figure 6-3: Incremental Increase in Purchase Likelihood by Incentive Level



6.5.4 Likelihood Sensitivity

Another metric to assess the effects of incentive change on willingness-to-pay responses is sensitivity. As described in the Methodology section, sensitivity is the total change in purchase likelihood divided by the change in the percentage price discount—0% purchase discount versus 100% purchase discount. Higher sensitivity values imply larger changes in purchase likelihood given a change in the purchase discount. To enable comparison across measures, the units in Table 6-1 are: (increase in purchase likelihood rating)/ (percent incentive increase).

The sensitivity was highest for measures with higher incremental costs compared similar measures with lower incremental costs. For example, LEDs have much higher incremental costs than CFLs, and much higher price sensitivity. The sensitivity comparison shows that respondents are 3.7 times more sensitive (0.052/0.014) to the price discount for LEDs than for CFLs. Similarly for appliances, the incremental costs and price sensitivity are highest for central air conditioning systems, then heat pumps, and finally refrigerators. The sensitivity comparisons show that respondents are 1.3 times more sensitive to the price discount for central air than for heat pumps and are 3.6 and 2.7 times more sensitive, respectively, to the price discount for central air conditioning systems and for heat pumps than for refrigerators. The sensitivity to the price discount for insulation is the same as that for central air but insulation is not directly comparable to the other lighting and appliance measures.

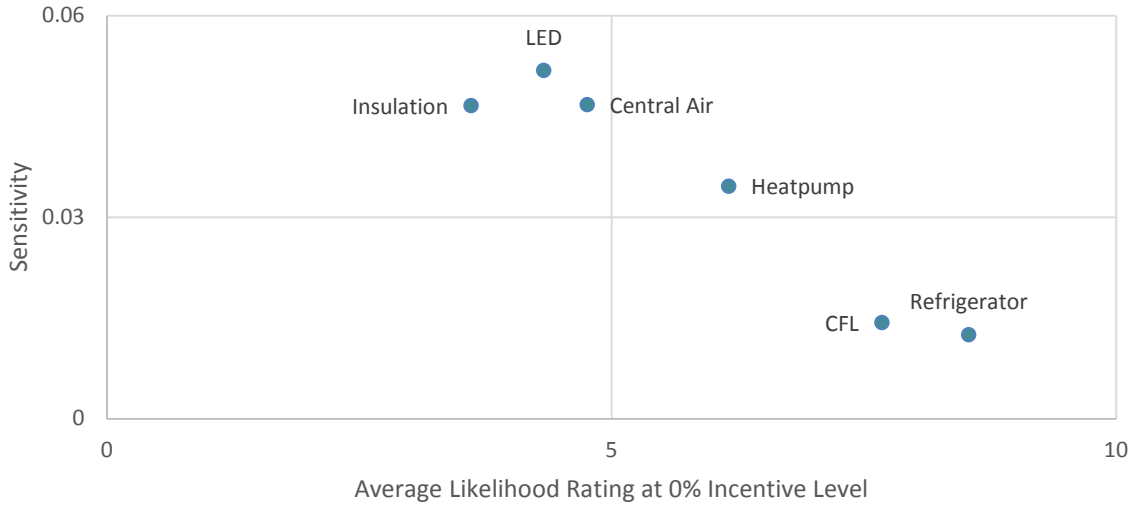
Table 6-1: Sensitivity by Product

	Sensitivity		Sensitivity
Refrigerator (n=367)	0.013	Central Air (n=182)	0.047
LEDs (n=484)	0.052	Insulation (n=367)	0.047
CFLs (n=484)	0.014	Heat pump (n=27)	0.035

6.5.5 Likelihood versus Sensitivity

As expected, sensitivity varied by average reported unincented purchase likelihood rating (Figure 6-4). Measures with the highest reported purchase likelihoods without incentive (such as CFLs and refrigerators) tended to have the lowest price sensitivity. In contrast, products with the lowest reported purchase likelihood without incentive (such as LEDs and Central Air) tended to have the highest price sensitivity. One small exception was insulation, whose sensitivity was slightly lower than expected based on respondents' reported unincented purchase likelihood ratings.

Figure 6-4: Sensitivity as a Function of Unincented Purchase Likelihood



6.6 FINDINGS BY EDC

The SWE team also analyzed willingness-to-pay responses by EDC.

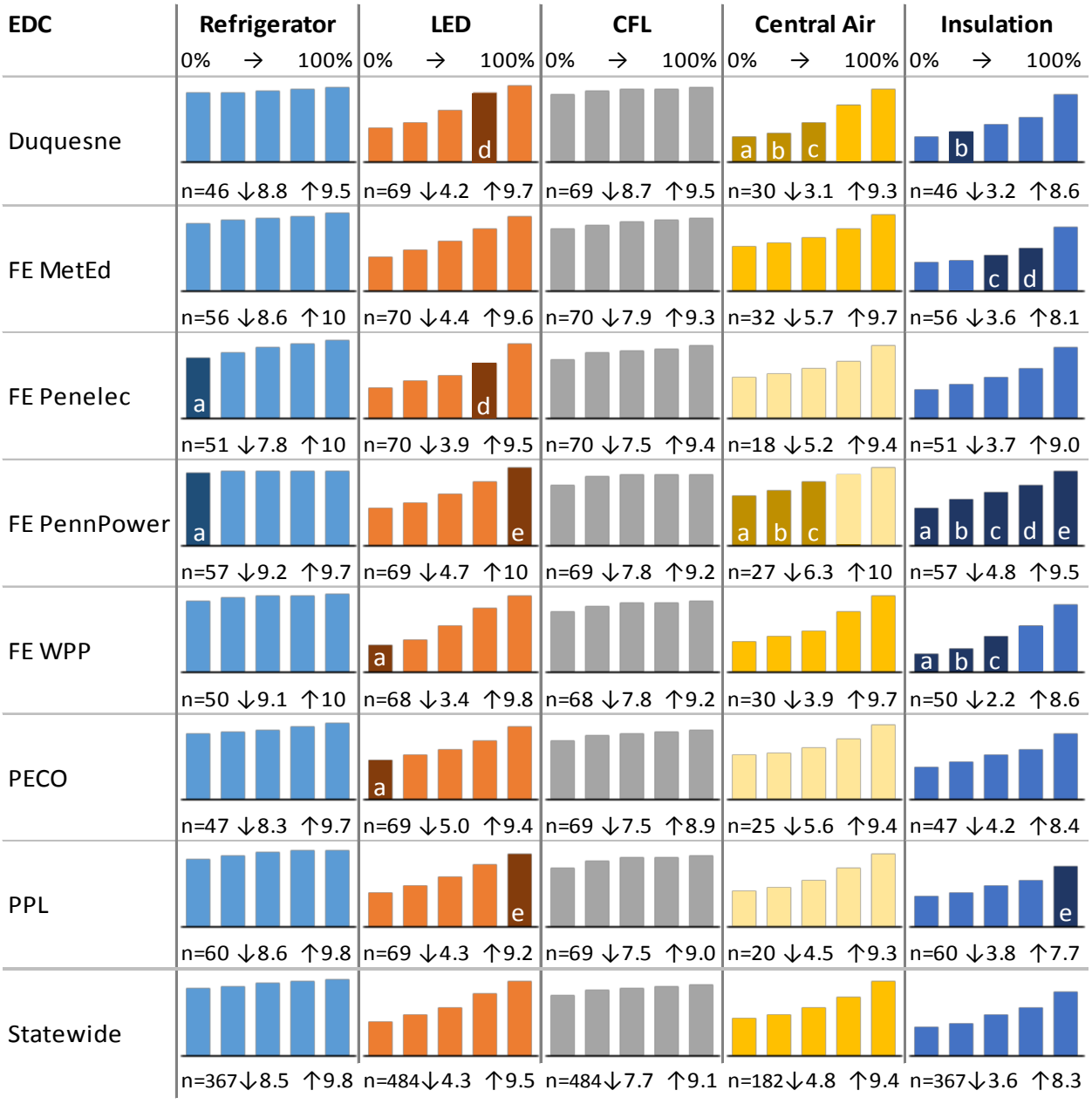
6.6.1 Purchase Likelihood

Figure 6-5 displays respondents' average purchase likelihood ratings at each incentive level across the seven EDCs. The key features of this figure are:

- **Bars.** Within each cell, the bars show the average purchase likelihood ratings for a given measure and EDC at 0% (left), 25%, 50%, 75%, and 100% (right) of the incremental cost incented.
- **Light shading**. This cell has a sample size below 30, and trends should be interpreted with caution.
- **Dark shading, labeled.** Within columns, darkly shaded bars with the same label indicate that purchase likelihood ratings differed significantly (p<.10) from one another for these EDCs at this incentive level.
- **"n=".** Sample size for this cell.
- **"↓".** Average purchase likelihood at minimum incentive (0%).
- **"↑".** Average purchase likelihood at maximum incentive (100% of incremental cost).

Although there were several significant differences, overall, responses for refrigerators, LEDs, and CFLs show no systematically different response patterns across EDCs. Although sample sizes were small, at lower incentive levels, PennPower respondents reported significantly higher purchase likelihoods for central air conditioning than Duquesne respondents. PennPower respondents also reported significantly higher insulation purchase likelihoods at all incentive levels than some other EDCs.

Figure 6-5: Average Purchase Likelihood Ratings by EDC



6.6.2 Likelihood Sensitivity

The bolded values in Table 6-2 indicate significantly different sensitivity values within a measure. (Recall that sensitivity is equal to the difference between purchase likelihood ratings at 100% incremental cost incentive and 0% incentive, divided by the percentage change in incentive.) Although there were significant differences across EDCs within each of the products except central air conditioning, these differences reveal few systematic trends in sensitivity. WPP had the highest sensitivity values for LEDs and insulation, but among the lowest sensitivity value for refrigerators. Penelec had the highest sensitivity values for refrigerators and CFLs.

Table 6-2: Sensitivity by EDC

	Refrigerator		LEDs		CFLs		Central Air		Insulation	
	Sensitivity	n	Sensitivity	n	Sensitivity	n	Sensitivity	n	Sensitivity	n
Duquesne	**0.007**	46	0.055	69	**0.008**	69	0.062	30	0.054	46
MetEd	0.013	56	0.052	70	0.014	70	0.040	32	0.045	56
Penelec	**0.022**	51	0.056	70	**0.019**	70	0.042	18	0.053	51
PennPower	**0.004**	57	0.053	69	0.014	69	0.037	27	0.047	57
WPP	**0.009**	50	**0.064**	68	0.013	68	0.057	30	**0.065**	50
PECO	0.014	47	**0.044**	69	0.015	69	0.038	25	**0.042**	47
PPL	0.013	60	0.050	69	0.015	69	0.048	20	*0.040*	60
Statewide	0.013	367	0.052	484	0.014	484	0.047	182	0.047	367

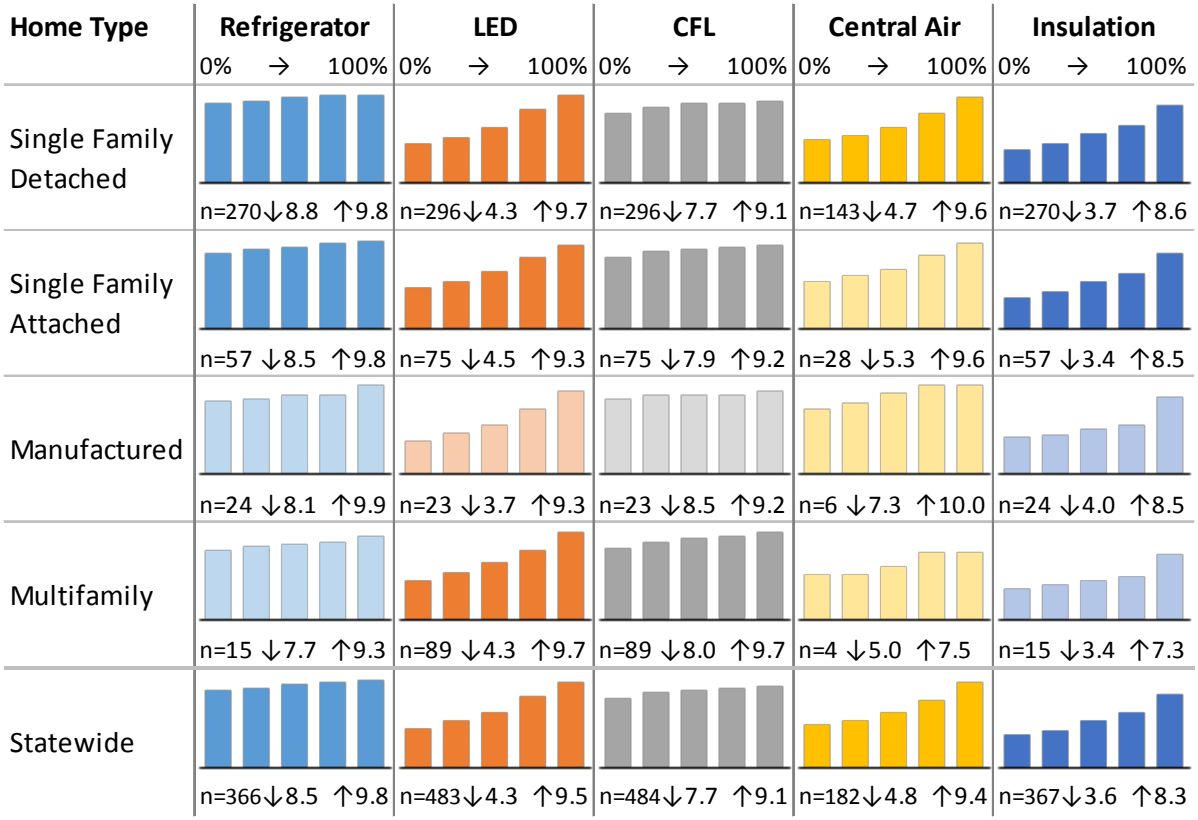
6.7 FINDINGS BY HOUSING TYPE

The SWE team also analyzed willingness-to-pay responses by home type.

6.7.1 Purchase Likelihood

Figure 6-6 shows respondents' average purchase likelihood ratings by home type across each measure. No significant differences were identified.

Figure 6-6: Average Purchase Likelihood by Home Type



6.7.2 Likelihood Sensitivity

The SWE team also found no evidence of significant differences in sensitivity by home type (Table 6-3).

Table 6-3: Likelihood Sensitivity by Home Type

	Refrigerator		LEDs		CFLs		Central Air		Insulation	
	Sensitivity	n	Sensitivity	n	Sensitivity	n	Sensitivity	n	Sensitivity	n
SF Detached	0.010	270	0.054	296	0.014	296	0.049	143	0.049	270
SF Attached	0.013	57	0.048	75	0.013	75	0.043	28	0.051	57
Multifamily	0.017	15	0.054	89	0.017	89	0.025	4	0.039	15
Manuf.	0.018	24	0.057	23	0.007	23	0.027	6	0.045	24
Statewide	0.013	366	0.052	483	0.014	484	0.047	182	0.047	367

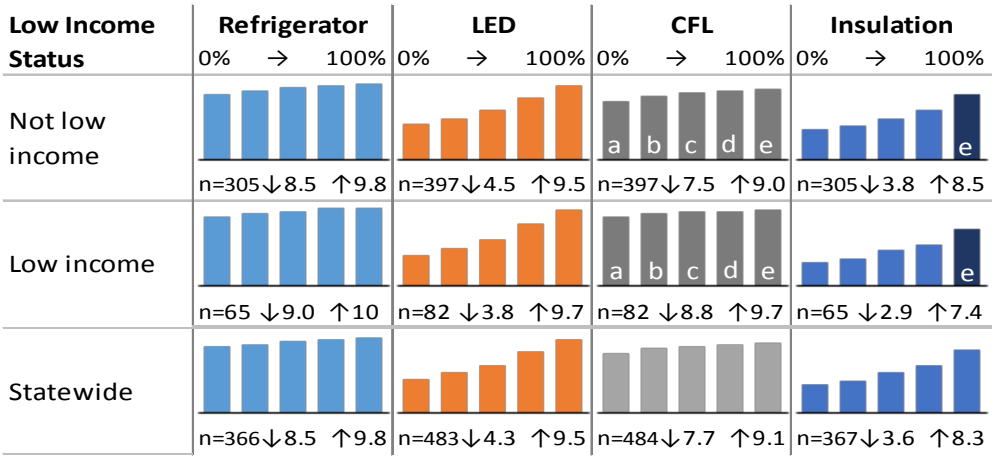
6.8 FINDINGS BY INCOME LEVEL

The SWE team also analyzed willingness-to-pay responses by low income status (respondents were classified as either low income or not low income, as identified by the EDCs). Relatively low sample sizes of low income respondents in the sample precluded detailed analyses of the differences in willingness-to-pay responses by income level, but statewide analyses are shown below.

6.8.1 Purchase Likelihood

The SWE team found few systematic differences in willingness-to-pay ratings across income level (Figure 6-7). Low income respondents' average purchase likelihood ratings for CFLs was somewhat higher than other respondents across all incentive levels, but low income respondents' reported average purchase likelihood ratings for insulation was lower than other respondents' at 100% incentive.

Figure 6-7: Average Purchase Likelihood by Low Income Status



6.8.2 Likelihood Sensitivity

The SWE team found that low income respondents were significantly less price sensitive for CFLs than other respondents (indicated by the bolded values in Table 6-4), but found no evidence of significant differences in sensitivity across the other three measures.

Table 6-4: Likelihood Sensitivity by Low Income Status

	Refrigerator		LEDs		CFLs		Insulation	
	Sensitivity	n	Sensitivity	n	Sensitivity	n	Sensitivity	n
Not low income	0.013	305	0.050	397	**0.015**	397	0.047	305
Low income	0.010	65	0.059	82	**0.009**	82	0.044	65
Statewide	0.013	366	0.052	483	0.014	484	0.047	367

6.9 CFL ANALYSIS

The SWE team also asked additional questions to understand respondents' CFL usage. Twenty-eight percent of respondents reported that they have at least one light socket in which they would never install a CFL[27]. In providing the reasons for these responses, respondents most frequently cited CFLs not

[27] These respondents reported an average of 15 sockets where a CFL could be installed but would likely never be installed.

fitting in the fixture, LEDs installed, poor lighting quality, and dimmer incompatibility. These respondents with light sockets in which they would never install CFLs reported an overall lower willingness to pay for CFLs than others (Table 6-5). These lower ratings for those who would never install a CFL in at least one socket are largely due to a notable proportion of respondents who rated themselves "not at all likely" to purchase a CFL at 0% and 100% of incremental cost incented (21% and 18% of respondents, respectively). No significant differences by EDC or housing type were observed.

Table 6-5: Purchase Likelihood and Sensitivity by Willingness to Install CFLs in any Socket

	Average Purchase Likelihood		
	0% Incentive	100% Incentive	**Sensitivity**
Never install CFL in at least 1 socket	6.6	7.8	0.012
Would install CFL in any socket	8.3	9.8	0.015

Relatively few surveyed respondents (11%) had no CFLs installed in their homes. Those respondents with no CFLs installed reported an overall lower willingness to pay for CFLs than those with CFLs, however (Table 6-6).

Table 6-6: Purchase Likelihood and Sensitivity by Current CFL Use

	Average Purchase Likelihood		
	0% Incentive	100% Incentive	**Sensitivity**
Have no CFLs (n=54)	4.9	7.3	0.024
Have at least 1 CFL (n=429)	8.0	9.3	0.013

Respondents also reported an average likelihood of 8.25 that they would replace their next burnt out CFL with a new CFL. While 68% of respondents reported they would be "extremely likely" to do so, 10% of respondents reported they would be "not at all likely" to do so. Those respondents who reported lower likelihoods mentioned LED and incandescent bulbs as the primary alternatives.

7 CONCLUDING REMARKS

Baseline research helps program administrators make educated decisions about the energy end uses and equipment that can be most effectively targeted with energy efficiency programs. Baseline research can also be used to characterize the type and efficiency levels of equipment that are installed in customer homes and businesses. These data serve to confirm program planning assumptions and may also be useful in evaluating energy savings impacts once programs are established. According to the National Energy Efficiency Best Practices Study's Portfolio Best Practices Report, "Objective baseline research reinforces the credibility of the portfolio and its underlying programs with diverse stakeholders and improves the accuracy of savings estimates, cost effectiveness calculations, and goals.[28] "

The results of this baseline study effort provide detailed and contemporary information across the seven largest EDCs in the state of Pennsylvania regarding baseline energy equipment saturations as well as electric equipment energy efficiency levels. These findings are intended to feed into the Electric Energy Efficiency Potential Assessment for the State of Pennsylvania conducted by the SWE team. Specifically, the baseline equipment saturation data is anticipated to supplement data collected through recent existing EDC appliance saturation studies, conducted with larger, more robust sample sizes than were possible through this endeavor. However, estimates of electric equipment efficiency levels are typically not a component of traditional appliance saturation assessments and data regarding the current saturation of energy efficient electric equipment is intended to be derived largely from the results of this report.

It was through the use of on-site data collection that the SWE team was able to collect accurate information regarding not only the type of equipment installed in residences throughout the state, but also the efficiency level of various major electric appliances, equipment, or end-uses. The study also collected valuable information on the levels of ceiling, wall, and floor insulation and other building shell characteristics. Finally, the contemporary nature of the data collection effort captures these equipment types and efficiency levels during similar periods of EDC energy efficiency program maturity. These factors help to provide justification for the inputs of the energy efficiency potential assessment as well as confidence in the ultimate estimates of electric energy efficiency savings potential.

[28] National Energy Efficiency Best Practices Study. Volume P1: Portfolio Best Practices Report. Itron Inc. 2008. Pg. P1-48.

Appendix A ON-SITE SURVEY INSTRUMENT

2013 Pennsylvania Statewide Residential Baseline Study – v4
On-Site Inspection Forms

PARTICIPANT INFORMATION

PI.1- Owner/Renter Name	**(A) Last Name**	**(B) First Name**
PI.2- First Name of Individual Present During Survey		
PI.3- House Address		
PI. 4- City/State/Zip		
PI.5- Telephone Number		
PI.6- Participant ID Number	XX – XXXX	

(Surveyor, please make sure all information above and throughout the document is completed and not left blank)

SURVEY DOCUMENTION (SD)

SD.1- Surveyor Last Name	
SD.2- Date Surveyed (MM/DD/YY)	
SD.3- Electric Distribution Company Name (check one)	☐ PECO ☐ PPL Electric Utilities ☐ Duquesne ☐ First Energy (West Penn Power) ☐ First Energy (PennPower) ☐ First Energy (Penelec) ☐ First Energy (MetEd)

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

BUILDING INFORMATION/CHARACTERISTICS (BI)

BI.1- House/Unit Type (check one)	1. Single-Family ☐ 2. Townhouse/Row house/Duplex ☐ 3. Multi-Family (Apartment ; 2-4 unit bldg) ☐ 4. Multi-Family (Apartment; 5+ unit bldg) ☐ 5. Manufactured/Mobile Home ☐		
BI.2- If Manufactured, type of manufactured home? (check one)	1. Single Wide ☐ 2. Double Wide ☐ 3. Not a manufactured home ☐		
BI.3 - If Apartment unit, number of floors per building? (Enter 999 if not an apartment)			
BI.4 - If Apartment unit, number of units per building? (Enter 999 if not an apartment)			
BI.5- Year Home Was Constructed (estimate)	____ ____ ____ ____		
BI.6- Front Facing Orientation (check one)	1. North ☐ 3. South ☐ 5. East ☐ 7. West ☐ 2. NE ☐ 4. NW ☐ 6. SE ☐ 8. SW ☐		
BI.7- Number of Occupants in Household (Greater than or equal to six months per year)			
BI. 8- Number of Bedrooms in Household			
BI.9- Weeks per Year Housing Unit Occupied			
BI.10- Predominant Framing Material (check one)	1. Wood Frame (2x6) ☐ 5. Wood/Block/Brick Combo ☐ 2. Wood Frame (2x4) ☐ 6. Metal ☐ 3. Concrete Block ☐ 7. Other ☐ 4. Brick ☐ 888. DK ☐		
BI.11- Roof Color (check one)	1. Reflective ☐ 2. Light Color ☐ 3. Dark Color ☐		
BI.12 - Is any part of the home directly over a…	(a)	Concrete Slab	1. Yes ☐ 2. No ☐
	(b)	Crawlspace?	1. Yes ☐ 2. No ☐
	(c)	Basement?	1. Yes ☐ 2. No ☐
	(d)	Apartment/Commercial Space?	1. Yes ☐ 2. No ☐
BI.13 - If Crawlspace, is it…	1. Enclosed ☐ 2. Open ☐ 3. No Crawl Space ☐		
BI.14 - If Basement, What Percent of basement is….. (Enter 999 if no basement)	(a)	Conditioned?	_____ %
	(b)	Unconditioned?	_____ %
BI.15 - Conditioned Basement… (Enter 999 if n/a)	(a)	Total Square Footage?	_____
	(b)	Avg. Ceiling Height (Ft)?	_____

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

BI.16 –Above Grade Conditioned Levels… (Enter 999 if n/a)	(a)	Total Square Footage?	_____
	(b)	Avg. Ceiling Height (Ft)?	_____
BI.17- Number of above grade CONDITIONED floors? (Check one)	1. One ☐ 2. Two ☐		3. Three or more ☐ 4. Split Level ☐
BI.18- Number of Electric Meters Located At Residence?			

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

INTERIOR LIGHTING

Socket #	Room Type	Socket Type	Existing Bulb Type	Control Type	Existing Bulb Watts
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					

Room Type Codes		Socket Type Code	Bulb Type Code	Control Type Code
1. Living Room	12. Garage	1. Medium- A-Frame	1. Incandescent	1. No Control
2. Kitchen	13. Attic	2. Medium- Globe	2. Modified Halogen	2. Occupancy Sensor
3. Dining Room	14. Other	3. Medium- Candle	3. CFL	3. Dimmer Switch
4. Bedroom	888. DK	4. Medium- Reflector	4. Tube Fluorescent	4. Photocell control
5. Bathroom		5. Candelabra	5. LED	888. Don't Know
6. Office/Den		6. Pin Base	6. 3-way Incandescent	
7. Foyer/Hallway		7. Night Light	7. 3-way CFL	
8. Utility Room		8. Other	8. Halogen	
9. Closet		888. Don't Know	9. Pulse Start MH	
10. Uncond. Basement			10. Other	
11. Media/Bonus Room			11. No Bulb	
			888. Don't Know	

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

INTERIOR LIGHTING

Socket #	Room Type	Socket Type	Existing Bulb Type	Control Type	Existing Bulb Watts
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					

Room Type Codes		Socket Type Code	Bulb Type Code	Control Type Code
1. Living Room	12. Garage	1. Medium– A-Frame	1. Incandescent	1. No Control
2. Kitchen	13. Attic	2. Medium- Globe	2. Modified Halogen	2. Occupancy Sensor
3. Dining Room	14. Other	3. Medium- Candle	3. CFL	3. Dimmer Switch
4. Bedroom	888. DK	4. Medium- Reflector	4. Tube Fluorescent	4. Photocell control
5. Bathroom		5. Candelabra	5. LED	888. Don't Know
6. Office/Den		6. Pin Base	6. 3-way Incandescent	
7. Foyer/Hallway		7. Night Light	7. 3-way CFL	
8. Utility Room		8. Other	8. Halogen	
9. Closet		888. Don't Know	9. Pulse Start MH	
10. Uncond. Basement			10. Other	
11. Media/Bonus Room			11. No Bulb	
			888. Don't Know	

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

INTERIOR LIGHTING

Socket #	Room Type	Socket Type	Existing Bulb Type	Control Type	Existing Bulb Watts
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106					
107					
108					
109					
110					
111					
112					
113					
114					
115					
116					
117					
118					
119					
120					

Room Type Codes		Socket Type Code	Bulb Type Code	Control Type Code
1. Living Room	12. Garage	1. Medium- A-Frame	1. Incandescent	1. No Control
2. Kitchen	13. Attic	2. Medium- Globe	2. Modified Halogen	2. Occupancy Sensor
3. Dining Room	14. Other	3. Medium- Candle	3. CFL	3. Dimmer Switch
4. Bedroom	888. DK	4. Medium- Reflector	4. Tube Fluorescent	4. Photocell control
5. Bathroom		5. Candelabra	5. LED	888. Don't Know
6. Office/Den		6. Pin Base	6. 3-way Incandescent	
7. Foyer/Hallway		7. Night Light	7. 3-way CFL	
8. Utility Room		8. Other	8. Halogen	
9. Closet		888. Don't Know	9. Pulse Start MH	
10. Uncond. Basement			10. Other	
11. Media/Bonus Room			11. No Bulb	
			888. Don't Know	

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

INTERIOR LIGHTING

Socket #	Room Type	Socket Type	Existing Bulb Type	Control Type	Existing Bulb Watts
121					
122					
123					
124					
125					
126					
127					
128					
129					
130					
131					
132					
133					
134					
135					
136					
137					
138					
139					
140					
141					
142					
143					
144					
145					
146					
147					
148					
149					
150					
151					
152					
153					
154					
155					
156					
157					
158					
159					
160					

Room Type Codes		Socket Type Code	Bulb Type Code	Control Type Code
1. Living Room	12. Garage	1. Medium- A-Frame	1. Incandescent	1. No Control
2. Kitchen	13. Attic	2. Medium- Globe	2. Modified Halogen	2. Occupancy Sensor
3. Dining Room	14. Other	3. Medium- Candle	3. CFL	3. Dimmer Switch
4. Bedroom	888. DK	4. Medium- Reflector	4. Tube Fluorescent	4. Photocell control
5. Bathroom		5. Candelabra	5. LED	888. Don't Know
6. Office/Den		6. Pin Base	6. 3-way Incandescent	
7. Foyer/Hallway		7. Night Light	7. 3-way CFL	
8. Utility Room		8. Other	8. Halogen	
9. Closet		888. Don't Know	9. Pulse Start MH	
10. Uncond. Basement			10. Other	
11. Media/Bonus Room			11. No Bulb	
			888. Don't Know	

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

EXTERIOR LIGHTING

Socket #	Room Type	Socket Type	Existing Bulb Type	Control Type	Existing Bulb Watts
1	15				
2	15				
3	15				
4	15				
5	15				
6	15				
7	15				
8	15				
9	15				
10	15				
11	15				
12	15				
13	15				
14	15				
15	15				
16	15				
17	15				
18	15				
19	15				
20	15				
21	15				
22	15				
23	15				
24	15				
25	15				
26	15				
27	15				
28	15				
29	15				
30	15				
31	15				
32	15				
33	15				
34	15				
35	15				
36	15				
37	15				
38	15				
39	15				
40	15				

Room Type Codes	Socket Type Code	Bulb Type Code	Control Type Code
15. Exterior Lighting	1. Medium- A-Frame 2. Medium- Globe 3. Medium- Candle 4. Medium- Reflector 5. Candelabra 6. Pin Base 7. Night Light 8. Other 888. Don't Know	1. Incandescent 2. Modified Halogen 3. CFL 4. Tube Fluorescent 5. LED 6. 3-way Incandescent 7. 3-way CFL 8. Halogen 9. Pulse Start MH 10. Other 11. No Bulb 888. Don't Know	1. No Control 2. Occupancy Sensor 3. Dimmer Switch 4. Photocell control 888. Don't Know

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

BULBS IN STORAGE

Bulbs #	Room Type	Socket Type	Bulb Type	Bulb Watts
1	16			
2	16			
3	16			
4	16			
5	16			
6	16			
7	16			
8	16			
9	16			
10	16			
11	16			
12	16			
13	16			
14	16			
15	16			
16	16			
17	16			
18	16			
19	16			
20	16			
21	16			
22	16			
23	16			
24	16			
25	16			
26	16			
27	16			
28	16			
29	16			
30	16			
31	16			
32	16			
33	16			
34	16			
35	16			
36	16			
37	16			
38	16			
39	16			
40	16			

Room Type Codes	Socket Type Code	Bulb Type Code
16. Storage	1. Medium– A-Frame 2. Medium- Globe 3. Medium- Candle 4. Medium- Reflector 5. Candelabra 6. Pin Base 7. Night Light 8. Other 888. Don't Know	1. Incandescent 2. Modified Halogen 3. CFL 4. Tube Fluorescent 5. LED 6. 3-way Incandescent 7. 3-way CFL 8. Halogen 9. Pulse Start MH 10. Other 11. No Bulb 888. Don't Know

MAJOR APPLIANCES

REFRIGERATORS (RF)

RF.1 Total Number of Refrigerators in the house (Enter "0" if none) ☐

	Manufacturer	Model #	Volume (Ft3)	How Many Months per Year Does Unit Operate?	Est. Age (# of Years)	ENERGY STAR Unit? (1-Yes 2-No/DK)	Type: 1-Top Freezer 2-Bottom Freezer 3-Side by Side 4- Single Door 5-Compact	Through the Door Ice? (1-Yes 2-No)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
RF.2								
RF.3								
RF.4								

FREEZERS-stand alone units (FZ)

FZ.2 Total Number of Freezers in the house (Enter "0" if none) ☐

	Manufacturer	Model #	Volume (Ft3)	How Many Months per Year Does Unit Operate?	Est. Age (# of Years)	ENERGY STAR Unit? (1-Yes 2-No/DK)	Type: 1-Upright 2-Chest
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
FZ.2							
FZ.3							

COOKING (CK)

CK.1- Oven Fuel Type (check one)	1. Electric	☐	2. Natural Gas	☐	3. Propane	☐	4. Other_____ ☐
CK.2- Stove Top Fuel Type (check one)	1. Electric	☐	2. Natural Gas	☐	3. Propane	☐	4. Other_____ ☐

MAJOR APPLIANCES

DISHWASHERS (DW)

DW.1 Total Number of Dishwashers in the house (Enter "0" if none) ☐

	Manufacturer	Model #	Est. Age (# of Years)	ENERGY STAR? (1-Yes 2-No/DK)	Estimated # of Loads per Week
	(a)	(b)	(c)	(d)	(e)
DW.2					
DW.3					

CLOTHESWASHERS (CW)

CW.1 Total Number of Clothes Washers in the house (Enter "0" if none) ☐

CW.2 Are there any shared units on-onsite? Yes ☐ No ☐

	Manufacturer	Model #	Est. Age (# of Years)	ENERGY STAR? (1-Yes 2-No/DK)	Estimated # of Loads per Week	Type: 1-Horizontal Axis 2-Vertical Axis
	(a)	(b)	(c)	(d)	(e)	(f)
CW.3						
CW.4						

CLOTHES DRYER(CD)

CD.1 Total Number of Clothes Dryers in the house (Enter "0" if none) ☐

CD.2 Are there any shared units on-onsite? Yes ☐ No ☐

CD.3 Dryer Fuel Type (check one)	1. Natural Gas ☐	2. Electric ☐	3. Propane ☐	4. Other _____ ☐

CD.4 Typical Drying Time (Check one use level for each time period)	Morning (5AM-12PM) (A)	Afternoon (12PM-5PM) (B)	Evening (5PM-8PM) (C)	Night (8PM-5AM) (D)
	1. Never/Rarely ☐	1. Never/Rarely ☐	1. Never/Rarely ☐	1. Never/Rarely ☐
	2. Sometimes ☐	2. Sometimes ☐	2. Sometimes ☐	2. Sometimes ☐
	3. Frequently ☐	3. Frequently ☐	3. Frequently ☐	3. Frequently ☐

SMALL HOUSEHOLD APPLIANCES

TELEVISION (TV)

TV.1 Total Number of Televisions in the house (Enter "0" if none) ☐

	TV Screen Size (Inches)	TV Type 1- CRT 2- Plasma 3- LCD 4 – LED 5 – Projection 6 - Other	Plug-In Peripherals (#)	Power Strip Present? 1-No Strip 2-Basic Power Strip 3. Smart Strip 888. Don't Know
	(a)	(b)	(C)	(d)
TV.2				
TV.3				
TV.4				
TV.5				
TV.6				
TV.7				

*** Leave blank if none ; enter 888 if don't know**

COMPUTERS & PERIPHERALS

	Computer Type	Total # in home	CRT Monitor (#)	Flat Screen Monitor (#)	Powered Off when Not In Use (#)	Plug-In Peripherals – Printers, Routers, Etc. (#)	Power Strip Present? 1-No Strip 2-Basic Power Strip 3- Smart Strip 888 – Don't Know
		(a)	(b)	(c)	(d)	(e)	(f)
PC.1	Desktops						
PC.2	Laptops						
PC.3	iPad/Tablet						

*** Leave (B-E) blank if none ; enter 888 if don't know**

OTHER CONSUMER ELECTRONICS

	Equipment	Total # in home	Continuously Plugged-In?
		(a)	(b)
CE.1	VCR		1 Yes ☐ 2 No ☐
CE.2	DVD/Blu-Ray		1 Yes ☐ 2 No ☐
CE.3	Gaming System		1 Yes ☐ 2 No ☐
CE.4	Stereo System		1 Yes ☐ 2 No ☐
CE.5	Mobile Phone Charger		1 Yes ☐ 2 No ☐
CE.6	Home Theater System		1 Yes ☐ 2 No ☐
CE.7	Fax Machine		1 Yes ☐ 2 No ☐

SEASONAL LOADS

	Equipment	Total # in home	Avg. Months per Year in Use	Est. Age (# of Years)	ENERGY STAR? (1-Yes; 2-No/DK)
		(a)	(b)	(c)	(d)
SEA.1	Dehumidifier				
SEA.2	Humidifier				
SEA.3	Air Purifier				

*** Leave (B-D) blank if none ; enter 888 if don't know**

	Fans	Total # in home	# Used Greater than 6 hrs/day	Avg. Months/Year in Use
		(a)	(b)	(c)
SEA.4	Ceiling Fans			
SEA.5	Portable Fans			

*** Leave (B) blank if none ; enter 88 if don't know**

PUMPS

	Equipment	Size (HP)	Motor Speed	Avg. Hours of Use Per Day	Pool Pump Timer Present?
		(a)	(b)	(c)	(d)
PMP.1	Pool Pump		1. Single Speed ☐ 2. Two-Speed ☐ 3. Variable Speed ☐ 888. DK ☐	1. 6 Hours ☐ 2. 12 Hours ☐ 3. 24 Hours ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐
PMP.2	Well Pump		1. Single Speed ☐ 2. Two-Speed ☐ 3. Variable Speed ☐ 888. DK ☐	1. 6 Hours ☐ 2. 12 Hours ☐ 3. 24 Hours ☐ 888. DK ☐	

*** Enter 0 in (A) if none ; enter 88 if don't know**

ADDITIONAL COMMENTS (Comments on Major and Small Household Appliances)

POOLS/HOT TUBS (POOL)

	Equipment	Total # in home	Heated?	If Heated, Is Pool Cover Used?	Fuel Type
		(a)	(b)	(c)	(c)
POOL.1	In Ground Pool		1 Yes ☐ 2 No ☐	1. Yes ☐ 2. No ☐ 3. Not Heated ☐	1 Natural Gas ☐ 3 Propane ☐ 2 Electric ☐ 4 Other ☐
POOL.2	Above Ground Pool		1 Yes ☐ 2 No ☐	1. Yes ☐ 2. No ☐ 3. Not Heated ☐	1 Natural Gas ☐ 3 Propane ☐ 2 Electric ☐ 4 Other ☐
POOL.3	Hot Tub		1 Yes ☐ 2 No ☐	1. Yes ☐ 2. No ☐ 3. Not Heated ☐	1 Natural Gas ☐ 3 Propane ☐ 2 Electric ☐ 4 Other ☐

2013 Pennsylvania Statewide Residential Baseline Study – v4
On-Site Inspection Forms

HVAC SPACE HEATING (HT)

HT.1 Total Number of Major (Non-Portable) Space Heating Systems in the House (Enter "0" if none) ☐

HT.2 Is Primary Space Heating Unit a shared unit? Yes ☐ No ☐

		HT.3	HT.4	HT.5
		PRIMARY HEAT	SECONDARY	OTHER
Primary Fuel Type (see Heating Code Table)	(a)			
System Type (see Heating Code Table)	(b)			
Manufacturer (Indoor Unit)	(c)			
Model # (Indoor Unit)	(d)			
Estimated Age (# of Years)	(e)			
Efficiency Rating (HSPF or AFUE)	(f)			
Heating Capacity (Btuh)				
Programmable Thermostat	(g)	1. Yes ☐ 888. DK ☐ 2. No ☐ 999. NA ☐	1. Yes ☐ 888. DK ☐ 2. No ☐ 999. NA ☐	1. Yes ☐ 888. DK ☐ 2. No ☐ 999. NA ☐
% of Household Heat Load Served (estimate)	(h)			

*** Enter 888 if don't know; If no secondary or other systems, leave blank.**

HEATING CODE TABLE

FUEL TYPE		SYSTEM TYPE	
1- Natural Gas	6- Wood	1- Furnace	7- Geo. Heat Pump
2- Electric	7- Dual-Fuel	2- Boiler (Water)	8- Ductless Heat Pump
3- Propane	8 - Other	3- Boiler (Steam)	9- Wood Stove
4- Kerosene	_____	4- Baseboard	10-Other
5- Oil		5- Wall Mounted Space Heater	888- Don't Know
6- Coal	888 – Don't know	6- Air Source Heat Pump	

ADDITIONAL HEATING QUESTIONS

HT.6 – When did the primary heating system last undergo a seasonal check-up? *Note: Seasonal check-up does not include a service repair call. Only applies to normal system maintenance.*	1. Less than 1 year ☐ 2. 1-2 years ☐ 3. More than 2 years ☐ 4. Never (Repair Only) ☐ 5. Equipment is < 1 year old ☐ 888. Don't Know ☐ 999. Not Applicable (No Central Heat) ☐
HT.7 - Awake Heating Temperature Setting	°F
HT.8 – Sleep Heating Temperature Setting	°F
HT.9 – Away Heating Temperature Setting	°F

2013 Pennsylvania Statewide Residential Baseline Study – v4
On-Site Inspection Forms

CENTRAL AIR CONDITIONING (CAC)

CAC.1 Total Number of Central Air Conditioning Units in the House (Enter "0" if none) ☐
(NOTE: Room Air Conditioning will be collected on the following page)

CAC.2 Is Primary Cooling Unit a shared unit? Yes ☐ No ☐

		CAC.3	CAC.4	CAC.5
		PRIMARY SYSTEM	SECONDARY	OTHER
System Type (check one)	(a)	1. Central AC Unit ☐ 2. Heat Pump ☐ 3. GSHP ☐	1. Central AC Unit ☐ 2. Heat Pump ☐ 3. GSHP ☐	1. Central AC Unit ☐ 2. Heat Pump ☐ 3. GSHP ☐
Manufacturer (Outdoor Unit)	(b)			
Model # (Outdoor Unit)	(c)			
Estimated Age (# of Years)	(d)			
Indoor Unit Location	(e)	1. Attic ☐ 2. Uncond. Basement ☐ 3 Crawl Space ☐ 4. Conditioned Space ☐ 888. DK ☐	1. Attic ☐ 2. Uncond. Basement ☐ 3 Crawl Space ☐ 4. Conditioned Space ☐ 888. DK ☐	1. Attic ☐ 2. Uncond. Basement ☐ 3 Crawl Space ☐ 4. Conditioned Space ☐ 888. DK ☐
Size (Btu/hr)	(f)			
Efficiency Rating (SEER or COP)	(g)			
Programmable Thermostat	(h)	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐
Ductless Mini-Split?	(i)	1. Yes ☐ 2. No ☐	1. Yes ☐ 2. No ☐	1. Yes ☐ 2. No ☐
Assess Sealing of Indoor Unit	(j)	1. Well Sealed ☐ 2. Partially Sealed ☐ 3. Poorly Sealed ☐	1. Well Sealed ☐ 2. Partially Sealed ☐ 3. Poorly Sealed ☐	1. Well Sealed ☐ 2. Partially Sealed ☐ 3. Poorly Sealed ☐

*** Enter .888 if don't know ; If no secondary or other systems, leave blank.**

ADDITIONAL COOLING QUESTIONS

CAC.6 – When did the primary cooling system last undergo a seasonal check-up? *Note: Seasonal check-up does not include a service repair call. Only applies to normal system maintenance.*	1. Less than 1 year ☐ 2. 1-2 years ☐ 3. More than 2 years ☐ 4. Never (Repair Only) ☐ 5. Equipment is < 1 year old ☐ 888. Don't Know ☐ 999. No Central Cooling ☐
CAC.7 Is the residence air conditioned most days, June – August?	1. Yes ☐ 888. Don't Know ☐ 2. No ☐ 999. Not Applicable ☐
CAC.8 - Awake Cooling Temperature Setting	°F
CAC.9 – Sleep Cooling Temperature Setting	°F
CAC.10 – Away Cooling Temperature Setting	°F

ROOM AC (RAC) AND PORTABLE SPACE HEATERS (PSH)

ROOM AIR CONDITIONERS (RAC)

RAC.1 Total Number of RAC Units in the house (Enter "0" if none) ☐

	Manufacturer	Model #	Size – Btu/hr	Age (# of Years)	ENERGY STAR? (1-Yes 2-No/DK)	EER Rating
	(a)	(b)	(c)	(d)	(e)	(f)
RAC.2						
RAC.3						
RAC.4						
RAC.5						
RAC.6						
RAC.7						

PORTABLE SPACE HEATERS (PSH)

PSH.1 Total Number of Portable Space Heaters in the house (Enter "0" if none) ☐

	Fuel Type	Wattage (999 if non-electric)	Overall Average Hours of Use per Day during the Winter?	Is the heater typically used between 6AM-8AM in winter?
	(a)	(b)	(c)	(d)
PSH.2	1. Electric ☐ 2. Non-Electric ☐			1. Yes ☐ 2. No ☐
PSH.3	1. Electric ☐ 2. Non-Electric ☐			1. Yes ☐ 2. No ☐
PSH.4	1. Electric ☐ 2. Non-Electric ☐			1. Yes ☐ 2. No ☐
PSH.5	1. Electric ☐ 2. Non-Electric ☐			1. Yes ☐ 2. No ☐
PSH.6	1. Electric ☐ 2. Non-Electric ☐			1. Yes ☐ 2. No ☐
PSH.7	1. Electric ☐ 2. Non-Electric ☐			1. Yes ☐ 2. No ☐

Inspection ID # _____

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

WATER HEATING (WH)

WH.1 Total Number of Water Heating Units in the House (Enter "0" if none) ☐

WH.2 Is Water heating system a shared unit? Yes ☐ No ☐

WATER HEATING

		WH.3	WH.4	WH.5
		PRIMARY	SECONDARY	OTHER
Primary Fuel Type (see WH Code Table)	(a)			
System Type (see WH Code Table)	(b)			
Manufacturer	(c)			
Model #	(d)			
Tank Capacity (enter 999 if N/A)	(e)			
Estimated Age (# of Years)	(f)			
Temp. Setting (°F)	(g)			
Efficiency Rating (EF)	(h)			
Pipe Wrap	(i)	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐
Water Heater Blanket	(j)	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐

WATER HEATING CODE TABLE

FUEL TYPE		SYSTEM TYPE	
1- Natural Gas	6- Coal	1- Stand Alone Tank	6- Other
2- Electric	7- Solar	2- Tankless (On Demand)	888- Don't Know
3- Propane	8- Other	3- Indirect Fired	
4- Kerosene	_____	4- Tankless Coil	
5- Oil	888- Don't Know	5- Heat Pump Water Heater	

ADDITIONAL WATER HEATING QUESTIONS

WH.5 – Total Number of Sinks in Household?	
WH.6 - # of Low Flow Faucet Aerators installed in the home? (1.5 GPM- Bathroom ; 2.2 GPM - Kitchen)	
WH.7 – Total number of Showers in Household?	
WH.8 - # of Low Flow Showerheads (2.0 GPM or less) installed in the home?	

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

INSULATION (IN)

INSULATION

		IN.1	IN.2	IN.3	IN.4
		Roof Cavity	Side Wall	Floor Cavity	Basement Wall
Insulation Present	(a)	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐
Insulation Type (see Table below)	(b)				
Avg. Insulation Thickness *Inches* (888-DK)	(c)				
Avg. Insulation R-Value (888-DK)	(d)				

INSULATION CODE TABLE

Insulation Type		
1 – Fiberglass Batt	5 – Dense Pack Cellulose	8 – Vermiculate
2 – Fiberglass Loose Fill	6 – Rigid Board	9 – Other _____
3 – Cellulose Loose Fill	7 – Spray/Expand Foam	888 – Don't Know
4 – Rock Wool Loose Fill		

WINDOWS(WIN)

WINDOWS

		WIN.1	WIN.2	WIN.3	WIN.4
		Building/Window Orientation			
		North/NE	East/SE	South/SW	West/NW
# of Windows	(a)				
# that are single paned	(b)				
# that are double paned	(c)				
# that are triple paned	(d)				
Average age (years)	(e)				
Average condition of windows	(f)	1. Excellent ☐ 2. Good ☐ 3. Fair ☐ 4. Poor ☐	1. Excellent ☐ 2. Good ☐ 3. Fair ☐ 4. Poor ☐	1. Excellent ☐ 2. Good ☐ 3. Fair ☐ 4. Poor ☐	1. Excellent ☐ 2. Good ☐ 3. Fair ☐ 4. Poor ☐
Low-E Coating	(g)	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐
Argon Filled	(h)	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐	1. Yes ☐ 2. No ☐ 888. DK ☐
Total Square-Footage per Building Side	(i)	_____ *sq ft.*	_____ *sq ft.*	_____ *sq ft.*	_____ *sq ft.*

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

AIR SEALING (AS) & DUCT SEALING (DS)

AIR SEALING

AS.1	**Qualitatively Assess Quality of Air Sealing:** **Well Sealed**: No Visible Gaps; Little to No Variation using Thermal Leak Detector **Partially Sealed**: Minimal Gaps ; Minor Variation using Thermal Leak Detector **Poorly Sealed**: Visible gaps ; Wide Variation using Thermal Leak Detector **Unable to Assess**: Cannot Visually Assess	1. Well Sealed ☐ 2. Partially Sealed ☐ 3. Poorly Sealed ☐ 888. Unable To Assess ☐
AS.2	Specify number of fireplaces?	
AS.3	Specify number of fireplaces where damper is present?	

DUCT SEALING

DS.1	Is duct work present in the home?	1. Yes 2. No 888. Don't Know
DS.1	Qualitatively assess quality of duct sealing:	1. Connections Sealed with Mastic ☐ 2. No observable leaks ☐ 3. Some observable leaks ☐ 4. Significant leaks ☐ 5. Catastrophic leaks ☐ 888. Unable To Assess ☐ 999. No Duct Work Present ☐
DS.2	Duct work (outside envelope) insulation level	1. R-8 or greater ☐ 2. R-4 – R-7 ☐ 3. Less than R-4 ☐ 888. Unable To Assess ☐ 999. No Duct Work Present ☐
DS.3	Specify % within conditioned space	1. 90% or more within conditioned envelope ☐ 2. 50% or more within conditioned envelope ☐ 3. Less than 50% within conditioned envelope ☐ 888. Unable to assess ☐ 999. No Duct Work Present ☐
DS.4	Specify duct work (outside conditioned space) location:	1. Uncond. basement ☐ 2. Crawl space ☐ 3. Attic ☐ 888. Unable to assess ☐ 999. No Duct Work Present ☐

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

ADDITIONAL COMMENTS ON MISCELLANEOUS COMMENTS

2013 Pennsylvania Statewide Residential Baseline Study – v4

On-Site Inspection Forms

DEMOGRAPHICS & OTHER (DEMO)

DEMO.1	**What is the Age of the Oldest Person Who Would Be Considered the Head of Household?**	1 24 Years or Younger ☐ 2 25 – 44 Years ☐ 3 45-54 Years ☐ 3 65 Years or Older ☐ 4 No Response ☐
DEMO.2	**What is the Highest Level of Education Completed by the Head of Household?**	1 Less than HS Grad. ☐ 2 HS Grad or Equiv. ☐ 3 Some College, No Degree ☐ 4 Associate's Degree ☐ 5 Bachelor's Degree ☐ 6 Graduate Degree or higher ☐ 7 No Response ☐
DEMO.3	**Do You Own/Rent this Home?**	1 Own ☐ 2 Rent ☐ 3 No Response ☐
DEMO.4	**Does Homeowner Pay Own Electric Bill or Does Someone Else Pay?** (e.g. the landlord, if home is rented)	1 Home Owner Pay ☐ 2 Someone Else Pays ☐ 3 No Response ☐
DEMO.5	**Have You Ever Had an Energy Audit Performed in Your Home?**	1 Yes ☐ 2 No ☐ 3 No Response ☐
DEMO.6	**Have you removed a refrigerator from your homein the past five years?**	1 Yes ☐ 2 No ☐ 3 No Response ☐ 4 Not Applicable ☐
DEMO.7	**If the Answer to #6 above is yes, what did you do with the old refrigerator that was removed from the home?** (Check only one)	1 Trash ☐ 2 I sold it ☐ 3 Picked up by retailer ☐ 4 Recycled by utility ☐ 5 Donated ☐ 6 Other (_____) ☐ 7 Not Applicable ☐
DEMO.8	**If the Answer to #6 above is yes, did you replace the removed refrigerator?**	1 Yes ☐ 2 No ☐ 3 No Response/Don't Know ☐ 4 Not Applicable ☐
DEMO.9	**Have you removed a freezer from your home in the past five years?**	1 Yes ☐ 2 No ☐ 3 No Response ☐ 4 Not Applicable ☐
DEMO.10	**If the Answer to #9 above is yes, what did you do with the old freezer that was removed from the home?** (Check only one)	1 Trash ☐ 2 I sold it ☐ 3 Picked up by retailer ☐ 4 Recycled by utility ☐ 5 Donated ☐ 6 Other (_____) ☐ 7 Not Applicable ☐
DEMO.11	**If the Answer to #9 above is yes, did you replace the removed freezer?**	1 Yes ☐ 2 No ☐ 3 No Response/Don't Know ☐ 4 Not Applicable ☐

Appendix B WILLINGNESS-TO-PAY SURVEY

Residential:
SECTION 1: REFRIGERATOR STARTS ON PAGE 1
SECTION 2: LIGHTING STARTS ON PAGE 3
SECTION 3: HEATING/COOLING STARTS ON PAGE 7
SECTION 4: BUILDING INSULATION STARTS ON PAGE 11

Programmer (or Interviewer): Please cover all four of the sections listed above but randomly vary the order of the four sections. Do not randomize the order of the questions within a section.

I would like to ask you a few questions about purchasing energy efficient products at different prices.

SECTION 1: REFRIGERATOR
[ASK IF RESPONDENT ≠ RENTER]

First, let's talk about refrigerators. For the next set of questions, suppose that your current refrigerator stopped working, and you needed to buy a new one. Further, suppose you had to choose between a standard model and a high-efficiency model with the same features. A high-efficiency refrigerator would use up to 20% less energy than a standard model; meaning, you could save approximately $13 per year on your electric bill for the life of the refrigerator, which is about 12 years. All together, that's about $155 in total savings over the lifetime of the refrigerator.

R1) If a high-efficiency refrigerator costs $40 more than a standard model but saved you $13 each year on your electric bill for up to 12 years, on a scale of 0-10, where 0 means 'not at all likely' and 10 means 'extremely likely', how likely would you be to purchase the high-efficiency model?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R1 = 10 → SKIP TO R6]

R2) What if the high-efficiency model cost $30 more than the standard model [**IF NEEDED**: and saved you $13 per year for 12 years on your bill]? How likely would you be to purchase the high-efficiency model [**IF NEEDED**: on a scale of 0-10, where 0 means 'not at all likely' and 10 means 'extremely likely']?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R2 = 10 → SKIP TO R6]

R3) What if the high-efficiency model $20 more [**IF NEEDED**: with the same annual savings]? How likely would you be to purchase it over the standard model?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R3 = 10 → SKIP TO R6]

R4) What if the high-efficiency model cost $10 more [**IF NEEDED**: with the same annual savings]? How likely would you be to purchase it?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R4 = 10 → SKIP TO R6]

R5) And finally, what if the high-efficiency model cost the same as the standard efficiency model [**IF NEEDED**: that is, there is no difference in cost between high efficiency and standard models], [**IF NEEDED**: and the high-efficiency model still saved you $13 per year for up to 12 years on your electric bill]? How likely would you be to purchase the high-efficiency model?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

Section 2: Lighting
[IF ALL OR SOME BULBS ARE INCANDESCENT → ASK R6 TO R20]
[IF ALL BULBS ARE CFL/LED → ASK R20]

Next, let's discuss light bulbs. Suppose one of your light bulbs burns out or stops working, and you needed to replace it with a new one. An LED bulb would use up to 80% less energy, which could save you approximately $3.5 a year on your electric bill, and the LED bulb would last up to 19 years longer than a standard replacement bulb. [**INTRODUCE LED INFO SHEET**] [**IF NEEDED**: That's total of about $70 in savings over the life of the LED bulb.] [**IF RESPONDENT ASKS EXPLAIN THAT WE ARE COMPARING TO NEW, EISA-COMPLIANT HALOGEN BULBS THAT USE APPROXIMATELY 30% LESS ENERGY THAN THE OLDER INCANDESCENT BULBS THEY ARE USED TO**]

R6) If an LED light bulb costs $19 more than a standard replacement but saved you $3.50 per year on your electric bill and lasted up to 19 years longer, on a scale of 0-10, where 0 means 'not at all likely' and 10 means 'extremely likely', how likely would you be to purchase the LED bulb?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R6 = 10 → SKIP TO R11]

R7) What if the LED bulb cost $14 more than a standard replacement [**IF NEEDED**: and still saved you $3.50 a year and lasted up to 19 years longer]? How likely would you be to purchase the LED bulb [**IF NEEDED**: on a scale of 0-10, where 0 means 'not at all likely' and 10 means 'extremely likely']?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R7 = 10 → SKIP TO R11]

R8) What if the LED bulb cost $10 more than a standard replacement [**IF NEEDED**: with the same annual savings and lifetime]? How likely would you be to purchase it over the standard replacement bulb?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R8 = 10 → SKIP TO R11]

R9) What if the LED bulb costs $5 more [**IF NEEDED**: with the same annual savings and lifetime]? How likely would you be to purchase it?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R9 = 10 → SKIP TO R11]

R10) What if the LED bulb cost the same as a standard replacement bulb [**IF NEEDED**: that is, there would be no difference in the cost between the LED and standard bulb], [**IF NEEDED**: and the LED bulb saved you $3.50 a year and lasted up to 19 years longer]? How likely would you be to purchase the LED bulb?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

Next, I have some similar questions for a different type of light bulb. As before, suppose that one of your light bulbs burns out or stops working, and you needed to replace it with a new one. A CFL bulb would use up to 65% less energy, saving you approximately $3.00 a year on your electric bill, and would last up to 6 years longer than a standard replacement bulb. [**INTRODUCE CFL INFO SHEET**] [**IF NEEDED**: That's total of $21.00 in savings over the life of the CFL bulb.]

R11) If a CFL costs $1.50 more than a standard replacement but saved you $3.00 each year on your electric bill and lasted up to 6 years longer, on a scale of 0-10, where 0 means 'not at all likely' and 10 means 'extremely likely', how likely would you be to purchase the LED bulb?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R11 = 10 → SKIP TO R16]

R12) What if the CFL bulb cost $1 more than a standard replacement [**IF NEEDED**: and still saved you $3.00 a year and lasted up to 6 years longer]? How likely would you be to purchase the CFL bulb [**IF NEEDED**: on a scale of 0-10, where 0 means 'not at all likely' and 10 means 'extremely likely']?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R12 = 10 → SKIP TO R16]

R13) What if the CFL bulb cost $0.75 more than a standard replacement [**IF NEEDED**: with the same annual savings and lifetime]? How likely would you be to purchase it over the standard replacement bulb?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R13 = 10 → SKIP TO R16]

R14) What if the CFL bulb costs $0.50 more [**IF NEEDED**: with the same annual savings and lifetime]? How likely would you be to purchase it?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

[IF R14 = 10 → SKIP TO R16]

R15) What if the CFL bulb cost the same as a standard replacement bulb [**IF NEEDED**: that is, there would be no difference in the cost between the CFL and standard bulb], [**IF NEEDED**: and the CFL bulb saved you $3.00 a year and lasted up to 6 years longer]? How likely would you be to purchase the CFL bulb?

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

R16) [**IF CFLs INSTALLED IN RESIDENCE**] When I did a walk-through of your home, I noticed that [**X**] of your light bulbs are CFLs. Why have you not installed CFLs in the other sockets?

_____

R17) Are there some light sockets in your home that you would never install CFL bulbs?

Yes
No → SKIP to R20

R18) [**If R17 = Yes**] How many sockets would you never install CFL bulbs?

_____ sockets

R19) [**If R17 = Yes**] Why would you never install CFLs in these sockets?

_____

R20) [**IF CFLs INSTALLED IN RESIDENCE**] The next time a CFL burns out or stops working, how likely are you to replace it with another CFL? Please indicate your likelihood on a scale of 0-10, in which 0 means 'not at all likely' and 10 means 'extremely likely'.

Not at all likely										Extremely likely
0	1	2	3	4	5	6	7	8	9	10

R21) [**IF R20 < 10**] What other bulb type would you consider?

_____

Energy Efficient Refrigerator

Average annual savings: $13
Uses 20% less energy than a standard model
Works for about 12 years

LED Light Bulbs

Average annual savings for one bulb: $3.50
One bulb costs about $20
Works for about 20 years

Compact Flourescent Light Bulbs (CFLs)

Average annual savings for one bulb: $3

One bulb costs about $2.50

Works for about 7 years

Energy Efficient Incandescent Bulbs

One bulb costs about $1

Works for about 1 year

Energy Efficient Air Source Heat Pump

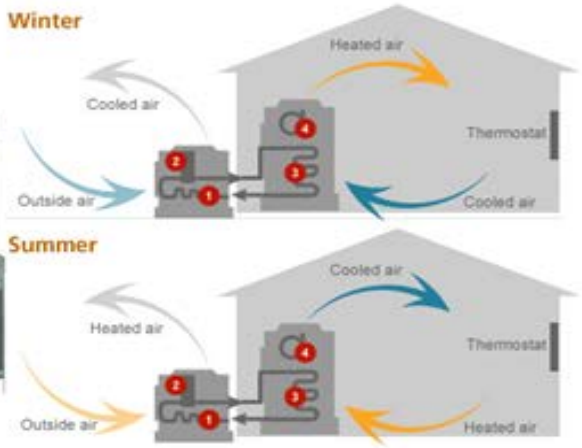


image courtesy of www.portlandgeneral.com

Average annual savings: $70
Uses about 10% less energy than a standard model
Works for about 12 years

Energy Efficient Air Conditioner

Average annual savings: $18.50
Uses about 13% less energy than a standard model
Works for about 14 years

Appendix C RECRUITMENT LETTERS

<Date>
<Name>
<Address One>
<City, State, Zip>

Dear Resident,

To support the energy efficiency goals associated with PA Act 129 of 2008, your home has been randomly selected as a potential participant for two statewide studies. The Pennsylvania Public Utility Commission (PUC) has contracted with GDS Associates and Market Decisions to conduct this research to find ways to help Pennsylvania consumers save energy and money. Penn Power is aware of and supports the PUC efforts to help its customers save energy.

Both studies will provide the PUC with a better understanding of how energy is consumed in homes and to expand and improve energy efficiency programs for residential customers.

- The first study will focus on the efficiency level of residential electric equipment, including lights, heating and cooling systems and electric appliances.
- The second study will track how many hours per day residential customers use their lights.

Qualified participants in the first study are eligible for a $100 incentive, while qualified participants in the second study are eligible for an $80 incentive. Participants willing to participate in both studies are eligible for a combined incentive of $180.

If you are interested in taking part in one or both research studies, please visit www.marketdecisions.com/PAenergy and complete a short survey, referencing ID number **<ID CODE>.** You also may contact Market Decisions toll-free at 1-800-293-1538 ext. 106 and reference the "PA Residential Energy Study." If you are unable to speak to someone directly, please leave your name and a telephone number on our answering machine and we will get back in touch with you.

Customers who complete the online survey or contact Market Decisions by telephone also will be entered into a drawing for one of three additional $100 Visa® Prepaid Cards.

As a potential participant, you also may be receiving a call from a Market Decisions representative in the coming days. The Market Decisions representative will ask permission to conduct an on-site visit for one or both of the studies mentioned. If you agree, a trained representative of the GDS Associates team will personally visit your home to gather information about the electric equipment located in your home, deploy metering equipment on seven or eight light bulbs in the home, or both.

All data collected for this study will be kept anonymously and simply used to help Penn Power and the PUC develop better energy efficiency programs. Your participation in this research would be appreciated, but is entirely optional. If you have any questions or concerns, please feel free to contact the PUC at 717-425-7584 or by email at ra-act129@pa.gov.

Thank you,
<EDC Contact>

Appendix D PHONE RECRUITING SCRIPTS

Pennsylvania Residential Baseline Study
Recruiting Script

Recruiter Information:

Note: All information for the random sample of residential customers eligible to be recruited will be maintained in an Excel database. This information will be treated as confidential and will include information on customer name, address, phone number, the dates of the first, second and third recruiting phone calls, the status of the recruiting for each customer, and the name of the SWE Team member doing the recruiting for each customer. For each customer contacted, a disposition status will be provided as follows:

1. *Customer agreed to participate in survey*
2. *Phone busy*
3. *Customer busy; Call back later (enter date and time to call back)*
4. *No answer, left voice mail message*
5. *No answer; no voicemail*
6. *Not interested*
7. *Number no longer in service*
8. *Other (please specify: _____)*

In the event that the phone is busy or there was no answer, Market Decisions will make two more attempts to contact the potential participant. When possible, GDS will leave a voice mail message with call back information. The final baseline study report will summarize this disposition data for the customers that were contacted by phone for this baseline study.

If there is no answer but an opportunity to leave a message and call back number, the following script will be used:

Answering Machine Message:

Hello, my name is _____ from Market Decisions, calling on behalf of the Pennsylvania Public Utility Commission. The PUC is conducting research to find ways to help consumers save energy.

You may have received a brief letter in the mail from PECO notifying you in advance of this call. I'm calling you to see if you're interested in participating in an on-site survey of your residence. If you are selected to participate, you will receive up to $180 for your time. A member of our staff may be contacting you in the next few days.

If you are interested in participating in this research, please feel free to call Market Decisions at 1-800-XXX-XXXX xXXX.

If you have any questions or concerns about this call, please call the Pennsylvania Public Utility Commission at 717-425-7584 and reference "Energy Usage Survey"

Thank you, and have a good day/night.

Recruitment Script

Hello, my name is _____ from Market Decisions and I am calling on behalf of the Pennsylvania Public Utility Commission, is <CONTACT NAME>, available?

When correct contact is located:
I am calling on behalf of the Pennsylvania Public Utility Commission to inform you of two potential opportunities to participate in a survey of Pennsylvania consumers about energy usage and equipment. I am not selling anything. You may have received a brief letter in the mail from PECO notifying the homeowners in advance of this call.

Did you have a chance to read the letter?

> **If No:** The letter was to inform you that PECO and the Pennsylvania PUC are working together to collect information through two different studies on the lighting, appliances, and other energy using equipment installed in your home. We are inviting homeowners to participate in one, or both, of these studies. Each study involves a trained surveyor visiting your home to collect information on the electric energy using equipment in your home. The PUC is conducting this research to find ways to help their Pennsylvania consumers save energy. Each eligible participating homeowner will receive a Visa Reward Card for up to $180 once the site visit is completed.
>
> **If Yes:** Great! As noted in the letter, the PA PUC and GDS Associates, the firm hired by the PUC to conduct this research, are conducting walk-through site visits of a large number of homes to gather further information about appliances, lighting, and other home building characteristics. We are conducting two studies with an opportunity to participate in either study or both.

Can I ask you a few questions to see if you're eligible to participate in one or both of these studies?

> **If No**: Ok, thank you for your time. Those are all the questions I have for you today. **<END CALL>**
>
> **If Yes**: Thank you.

SCREENING QUESTIONS:

Q1: What type of home do you have? [SELECT ONE]

a. Single-family
b. Townhouse/Rowhouse/Duplex
c. Multi-Family Building
d. Mobile home/manufactured home
e. Other (specific: _____

Q2: Are you currently living at _____? (FILL ADDRESS)

INTERVIEWER: *If this is not the respondent's current address or if they refuse to confirm their address, treat the case as "quota bin full," as we do not know if they now live in the study area. Ask remaining screening questions and then terminate the call.*

Q3: Do you currently own your home or do you rent?

a. Own
b. Rent

Q4: What is your age?

ENTER AGE: _____

18-39
40-64
65+

Q5: What fuel do you use to primarily heat your home? (circle one)?

a. Electricity
b. Natural Gas
c. Oil (#2 fuel oil)
d. Kerosene
e. Wood
f. Solar
g. Coal
h. Other
i. Don't know

INTERVIEWER: *Review quotas sheets to determine if quota bin is full.*

(IF QUOTA BIN IS FULL): Thank you for your responses and willingness to participate. Unfortunately, we have already scheduled on-site visits at homes in the PECO territory that have similar characteristics as your household. If you would be willing, we will keep your name on a separate list and contact you again over the next two weeks should any other homes cancel or become unavailable. Is that ok?

If No*:* That's ok, I understand. Thank you very much for your time. Have a good day/night. **<END CALL>**

If Yes: Thank you. Should we receive any cancellations over the next two weeks as we conduct surveys in your area, we will contact you again to schedule the on-site visit. To thank you for your initial interest, your name will be entered into a random drawing for three $100 pre-paid Visa cards. Have a great day*!* **<END CALL>**

(IF RESPONDENT QUALIFIES): To participate in this research, we would like to send a trained surveyor to your home. Would you be willing to let one of our representatives come to your home for this research?

If No: That's ok, I understand. Thank you very much for your time. Have a good day/night. **<END CALL>**

If Yes: Great. As I mentioned earlier, there are two surveys that are a part of this research study.

The first survey is designed to count and collect data on all your electric-using equipment. The surveyor would count the number of lighting sockets in your home and collect the make and model information off other electric appliances and equipment. This study will be used to identify the current market for future electric energy efficiency opportunities throughout the PECO territory and the state. Each participating homeowner will receive a Visa Rewards Card for $100 for participating.

We expect these site visits will last approximately 1.5 to 2.5 hours, depending on the size of the home. The information collected from your home will be kept confidential.

For the on-site visit, we request that the homeowner, or spouse, be home at the time of the survey and be available to answer a few questions for the field surveyor.

Surveyors will be in your area between [start date] and [end date]. Are you available to participate during this time period?

If No: That's ok, I understand. Thank you very much for your time. Have a good day/night. **<END CALL>**

If Yes: Great, the dates and times that we have available are:

INTERVIEWER: Review schedule and read available times and dates back to respondent.

M-F:	*8am*
	12pm
	Late afternoon, flexibility: either 4pm, 5pm or 6pm
Saturday:	*10am*
	2pm

INTERVIEWER: If respondent is not available for any open appointments, read:

Thank you for your willingness to participate, but unfortunately these are the only appointments that we have available in your area. If you would be willing, we will keep your name on a separate list and contact you again should any other appointments become available. Is that ok?

If No: That's ok, I understand. Thank you very much for your time. Have a good day/night. **<END CALL>**

If Yes*:* Thank you. Should we receive any cancellations over the next two weeks as we conduct surveys in your area, we will contact you again to schedule the on-site visit. To thank you for your initial interest, your name will be entered into a random drawing for three $100 pre-paid Visa cards. Have a great day*!* ***<END CALL>***

INTERVIEWER: Before reading paragraph below, check to see if there are open metering study slots. If no slots are available, ***<SKIP TO INVITE>***

As I mentioned earlier, the PA PUC is conducting a second study regarding light usage by Pennsylvania homes. The goals of the study are to provide the PA PUC with a better understanding of how many hours per day consumers use their lights in various areas of the home, and to improve the energy efficiency programs offered to homeowners. The surveyor would ask you a few additional questions and deploy metering equipment (loggers) on 7-8 light bulbs to measure light usage in your home. The loggers are non-invasive, operate on their own battery power, and simply record how long a light is turned on or off each day. The loggers would be installed for a period of 9 months – 1 year, require no maintenance, and again, record no other information than how long a light is turned on or off each day.

We estimate this would require an additional 20-30 minutes to the site visit. By participating in this study, at the time of the on-site visit, you'll be receiving a $40 pre-paid Visa reward card for your cooperation. After the appointment, we will be contacting you to schedule a pick-up of the metering devices. During the pick-up, we will provide you with a second $40 pre-paid card for a total of $80.

Would you be interested in participating in this metering study?

If No: That's ok, however, we do appreciate your willingness to participate in the on-site survey. **<READ INVITE>**

If Yes: Great, thank you for participating in both studies. **<READ INVITE>**

INVITE:

A surveyor from GDS Associates will come to your address at [read time] on [read date] and will provide you with proper identification. If you should need to cancel or reschedule, or if you have any questions, please contact the project manager, <insert name>, at 1-800-XXX-XXXX xXXX and she will be happy to accommodate you. We will be sending you a confirmation letter in the next few days which will re-state

the time and the date of your scheduled appointment. The surveyor will have a letter of introduction and will call you 24 to 48 hours in advance of your site visit to confirm the appointment. Thank you again for your willingness to participate. Have a nice day/night.