Appendix J:

Office of the Public Advocate 2018 Maine Low-Income Household Energy Efficiency Baseline Study

10/22/2018

THE MAINE OFFICE OF THE PUBLIC ADVOCATE

Maine Low-Income Household Energy Efficiency Baseline Study

FINAL REPORT
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prepared for
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prepared by

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1 Executive Summary

This report presents findings from the Maine Residential Low-Income Household Energy Efficiency Baseline Study. The objective of this study was to develop a representative profile of the energy consumption and energy efficiency characteristics of low-income homes in the state of Maine. This analysis is based on 68 on-site surveys completed from a random sample of low-income households throughout Maine. GDS Associates, Inc. (GDS)[1] conducted these on-site surveys from February to June 2018. All the housing characteristics and energy using equipment data presented in this report were collected by trained GDS surveyors through on-site surveys. These 68 low-income households were recruited through mail, email and telephone contacts.

This report focuses on presenting highlights of the survey data collected and the methodology used to select the sample of Maine households for this study. These on-site surveys collected comprehensive data regarding primary energy end uses in homes occupied by low-income residents (i.e., space heating, space cooling, water heating, lighting, appliances, and other plug loads) as well as energy and equipment used for transportation. The study was designed by a collaborative group including staff from the Maine Office of the Public Advocate (OPA), the Efficiency Maine Trust, Synapse Energy Economics and GDS. GDS has used detailed data collected through these on-site surveys to identify the remaining energy savings opportunities for low-income households in Maine.

GDS collected all baseline data through in-person, on-site visits to a representative random sample of low-income households selected for this study. The results of the completed 68 on-site surveys provide a ±10% margin of error at a 90% statistical confidence interval level for low-income households at the statewide level. The random sample for this study was selected from a population of 38,322 participants[2] in Maine's Low-Income Heating Energy Assistance Program (LIHEAP)[3] who are responsible for paying their monthly electric bill.

This baseline study report provides the following types of information about energy consumption and energy efficiency characteristics of low-income homes in Maine:

- End-use profiles of electric customers including current saturation and energy efficiency levels of energy using equipment in low-income households in Maine
- Information of the amount of insulation in ceilings, walls and floors of low-income households in Maine
- Identification of remaining energy efficiency potential savings for household lighting and appliances
- Comparison of the building and energy using equipment characteristics of low-income households in Maine relative to the population of all residential households in Maine

To compare the building and energy efficiency characteristics of LIHEAP program participants to the general population of all residential households in Maine, GDS selected the September 2015 "Maine Single-Family Residential Baseline Study" published by Efficiency Maine as the best source of comprehensive data on the energy

[1] GDS Associates, Inc.(GDS) is a 175-employee engineering and management consulting firm founded in 1986. The Maine Office of the Public Advocate selected GDS to complete this study through a competitive solicitation process during the summer of 2017. GDS consultants who live and work in Maine conducted 90 percent of the 68 completed on-site surveys.

[2] The population of Maine Low-Income Heating Energy Assistance Program (LIHEAP) participants was provided to GDS by the Efficiency Maine Trust under the provisions of a confidentiality agreement.

[3] The Low-Income Home Energy Assistance Program (commonly called LIHEAP or HEAP) provides money to help low-income homeowners and renters pay heating costs. Eleven Community Action Programs distribute the funds throughout Maine, in most cases directly to the fuel vendors. The program is not intended to pay for all heating costs, but to assist in paying the heating bills. LIHEAP is federally-funded through the Department of Health and Human Services. The Federal government establishes funding levels annually. LIHEAP is targeted to low and very low-income homeowners and renters.

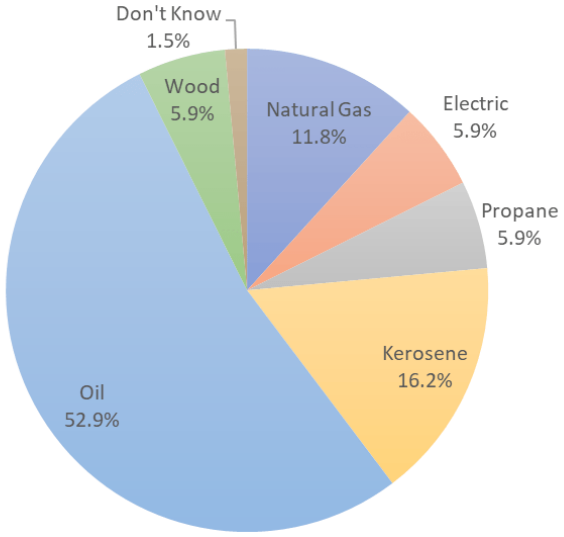
efficiency characteristics of all households in Maine.[4] This report is provided in an embedded pdf file in the appendices of this report. Throughout this report, tables are provided presenting comparisons of the 2018 data on LIHEAP households to the 2015 data on all single-family households in Maine.

Listed below are the highlights of the findings from the 68 on-site surveys completed by GDS for this study.

1.1 SPACE HEATING, SPACE COOLING AND WATER HEATING EQUIPMENT

As shown in Figure 1-1 below, nearly fifty-three percent (52.9%) of Maine's LIHEAP households use oil as their primary space heating fuel. The percent of LIHEAP households using kerosene, natural gas, wood, propane and electricity as their main home heating fuel are 16.2%, 11.8%, 5.9%, 5.9% and 5.9% respectively.

FIGURE 1-1 2018 LIHEAP PRIMARY SPACE HEATING FUEL BREAKDOWN



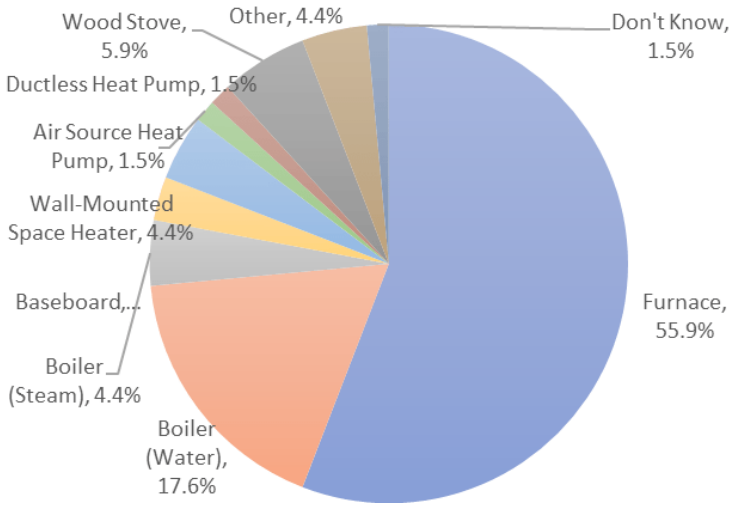
(Based on 68 completed surveys)

Census data indicates that 72% of all homes in Maine use fuel oil or kerosene as their primary heating fuel. Sixty-nine percent (69.1%) of LIHEAP homes in Maine use fuel oil or kerosene as their primary heating fuel.

Approximately seventy-eight percent (77.9%) of the LIHEAP households surveyed for the Maine OPA baseline study have central boilers or furnaces installed in their homes. Figure 1-2 below shows a breakdown of the space heating equipment installed in surveyed low-income homes for **primary** space heating systems.

[4] Efficiency Maine, "Maine Single-Family Residential Baseline Study", published on September 14, 2015. The objective of the Efficiency Maine 2015 study was to develop a representative baseline for single-family homes in the state of Maine (not just low-income homes). This analysis is based on 41 on-site audits of single-family homes throughout Maine, which NMR Group conducted between April and June of 2015. The study also included a telephone survey of 164 homeowners, analysis of Census Bureau data, and a review of other recent baseline studies.

FIGURE 1-2 2018 LIHEAP PRIMARY SPACE HEATING EQUIPMENT BREAKDOWN

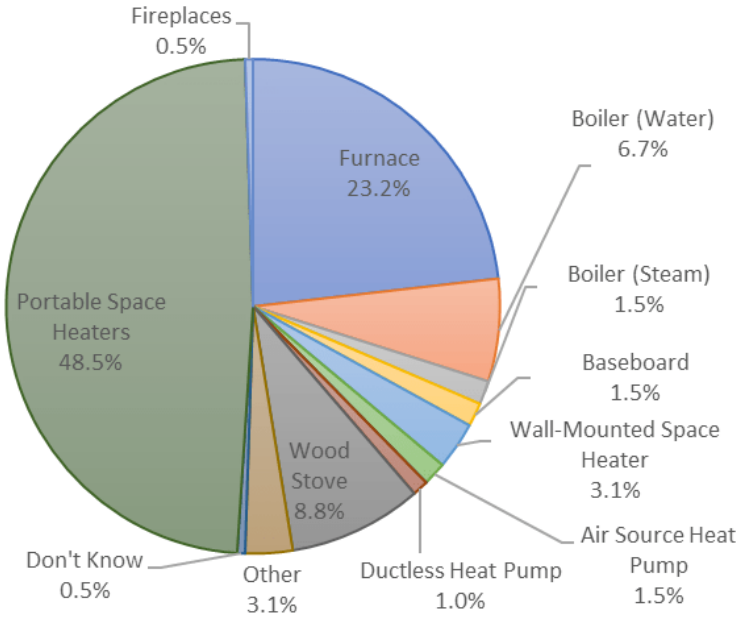


(Based on 68 completed surveys)

Figure 1-3 provides a breakdown of space heating equipment for all primary and supplemental heating units observed in surveyed low-income homes. Forty-two of the 68 surveyed homes (61.8%) had supplemental space heating units in addition to a primary unit. For the purposes of this analysis, a supplemental space heating unit was defined as any heating system that was used in addition to non-portable primary heating units. Portable space heaters represented the majority (48.5%) of all heating equipment. Furnaces and boilers accounted for the next largest percentage of heating units at 31.4%.

Forty-two of the 68 surveyed low-income homes or sixty-two percent (62%) have at least one of the following types of supplemental heating equipment: woodstoves, wood boilers, fireplaces, portable electric space heaters, electric baseboard heat, or ductless mini-splits.

FIGURE 1-3 2018 LIHEAP SPACE HEATING EQUIPMENT BREAKDOWN FOR ALL OBSERVED UNITS (PRIMARY & SUPPLEMENTAL)



(Based on 68 completed surveys)

Central heating equipment in Maine's low-income homes has an average Annual Fuel Utilization Efficiency (AFUE) lower than the current federal standard for fossil-fuel fired boilers and furnaces. The 13 primary oil-fired boilers and 22 primary oil-fired furnaces [5] in the 68 surveyed homes for which energy efficiency data was readily available had an average efficiency of 76% and 78% AFUE respectively. Boiler and furnace efficiency is measured in Annual Fuel Utilization Efficiency (AFUE).

- The current standards for residential hot water boilers require a minimum efficiency of 82% for gas-fired equipment and 84% for oil-fired equipment. In 2016, DOE finalized new standards for residential boilers that will raise the minimum efficiency levels to 84% and 86% for gas-fired and oil-fired hot water boilers, respectively. The new standards will take effect in 2021.
- The U.S. Department of Energy (DOE) finalized the current standards for non-weatherized gas furnaces in 2007 and they took effect in 2015. The standard for non-weatherized gas furnaces was set at 80% AFUE, a level already met in 2007 by 99% of furnaces sold.[6] The current federal energy efficiency standard for residential non-weatherized oil-fired furnaces is 83%.[7]

Table 1-1 below compares the average efficiencies of surveyed oil-fired boilers and furnaces in Maine's low-income homes to the average AFUE efficiencies of oil-fired boilers (83%) and furnaces (81%) for all Maine households as defined in the 2015 baseline study. (A more detailed analysis of the average efficiencies of primary heating equipment in LIHEAP homes beyond oil-fired systems is included later in this report.)

TABLE 1-1 AVERAGE EFFICIENCY FOR OIL-FIRED PRIMARY SPACE HEATING EQUIPMENT

	2015 Statewide Study				2018 LIHEAP Study			
Equipment	Fuel	Number of Systems	Efficiency Unit	Average Efficiency	Fuel	Number of Systems [8]	Efficiency Unit	Average Efficiency
Boilers	Oil	27	AFUE	83%	Oil	13	AFUE	76%
Furnaces	Oil	7	AFUE	81%	Oil	22	AFUE	78%

Figure 1-4 below provides the breakdown of supplemental space heating units observed in the 68 surveyed homes. The figure below includes only units explicitly reported to be in use for space heating. For this reason, existing fireplaces reported as not used for space heating were excluded. Fifty-four of the 86 reported supplemental heating units (62.7%) were portable space heaters. Thirteen of the 86 reported supplemental heating units (15.1%) were wood stoves. Table 4-8 in Section 4 of this report provides data on the number and type of supplemental space heating equipment.

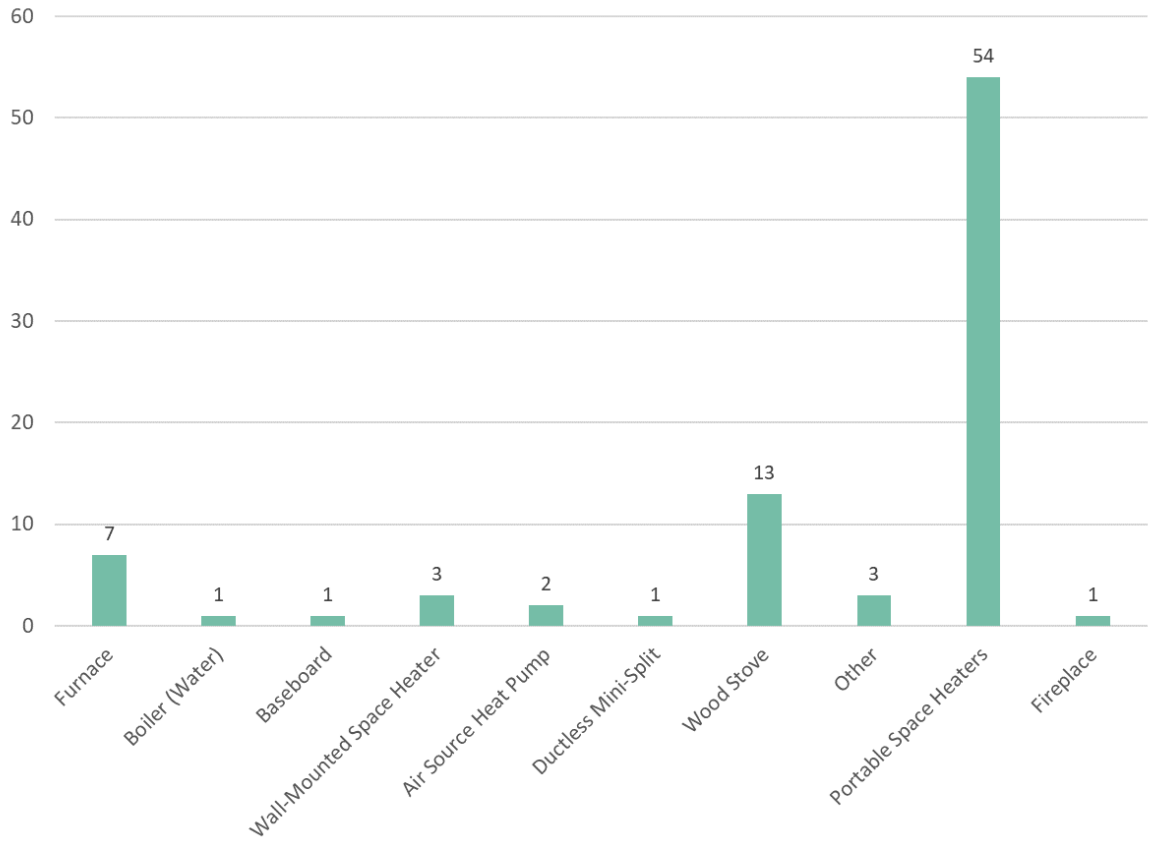
[5] Information available from the Appliance Standards Project notes that furnaces are the most common type of home heating equipment in the United States. Furnaces burn natural gas, propane, or oil for heat and use a fan to distribute the heat through a duct system. They are often installed in conjunction with a central air conditioner, using the same air distribution system. Non-weatherized gas furnaces, which are installed in basements, utility rooms or other indoor spaces, are by far the most common type. Weatherized furnaces for outdoor installation, such as on rooftops, are sometimes used in warmer climates. Furnace efficiency is measured in annual fuel utilization efficiency (AFUE).

[6] See Appliance Standards Project fact sheet at https://appliance-standards.org/product/furnaces. Also see the Code of Federal Regulations, Title 10, Chapter II, Sub Chapter D, Part 430, Subpart C, Section 430.32. .

[7] Id.

[8] Also see Table 4-5 in this report for a detailed breakdown of the types of fuels (oil, natural gas, kerosene, etc.) used by the primary space heating equipment installed in homes participating in this baseline study.

FIGURE 1-4 2018 LIHEAP SPACE HEATING EQUIPMENT BREAKDOWN FOR SUPPLEMENTAL HEATING UNITS[9]



(Based on 68 completed surveys)

Only 3 of the 68 homes (4%) surveyed have central air conditioning equipment. Room air conditioning is significantly more prevalent in surveyed LIHEAP homes, with 36 of 68 homes (52.9%) identified by GDS surveyors as having at least one room air conditioner.

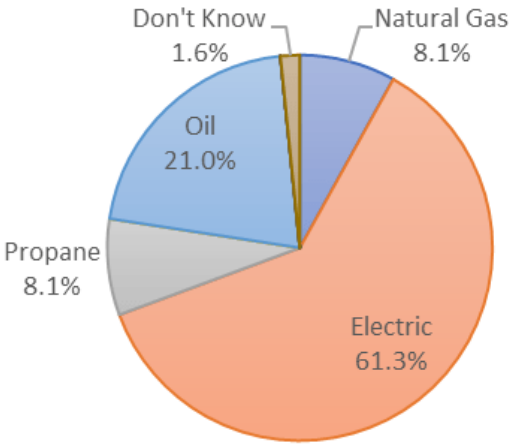
Most domestic water heating equipment in low-income homes is oil-fired or electric. GDS surveyors were able to clearly identify the types of water heating equipment and fuel type in 62 of the 68 homes. Figure 1-5 below shows a breakdown of the primary fuel used for these 62 primary water heating units. Sixty-one percent (61.3%) of low-income homes use electricity as the primary fuel for water heating and twenty-one percent (21.0%) use oil as the primary fuel for water heating. Natural gas and propane-fired primary systems each accounted for 8.1% of primary water heating units.

Two homes of the 68 surveyed LIHEAP homes had an additional supplemental water heating unit on-site, for a total of 64 water heating units in surveyed homes. Both supplemental units observed were stand-alone, electric tank units. Figure 1-6 provides a breakdown by fuel type of the total 64 observed water heating units.

Figures 1-5 and 1-6 provide information on the breakdown of fuels used for water heating in the 68 surveyed LIHEAP homes for primary units versus all primary and supplemental units respectively.

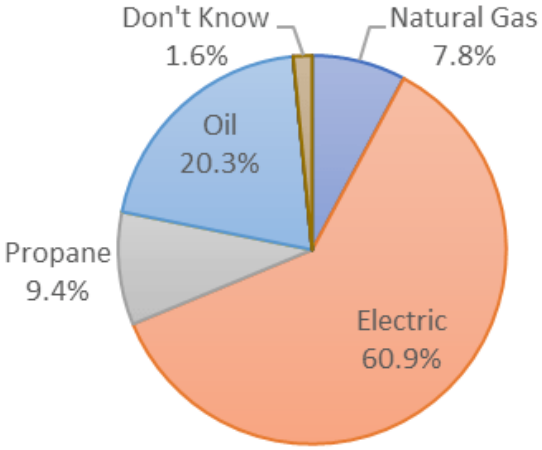
[9] Refer to Table 4-9 for more information on the number of portable space heaters in the 68 surveyed homes.

FIGURE 1-5 PRIMARY WATER HEATING FUEL BREAKDOWN



(Based on 62 water heating units)

FIGURE 1-6 WATER HEATING FUEL BREAKDOWN (PRIMARY & SUPPLEMENTAL)

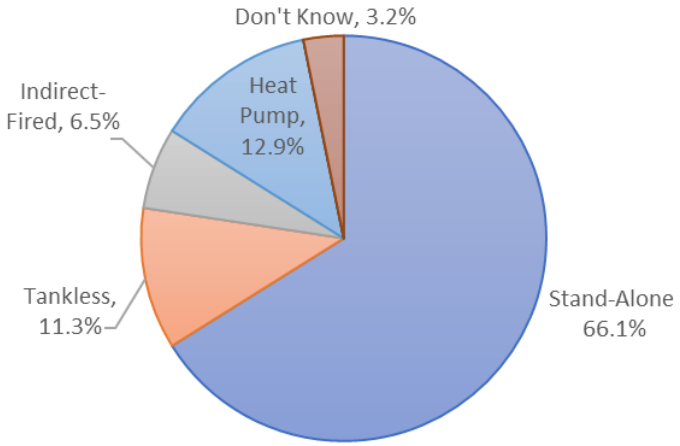


(Based on 64 water heating units – 62 primary units, 2 supplemental units)

Figures 1-7 and 1-8 provide information on types of water heater equipment for primary water heating systems and all water heating systems. Figure 1-7 provides a breakdown of the primary water heating equipment installed in Maine's low-income homes. It is important to note that 2 homes had more than one water heating system. There were a total of 64 water heating systems installed in the 62 homes where the type of water heating equipment was observable. The majority of primary water heaters (66.1%) were stand-alone tanks, 12.9% were heat pump water heaters, 11.3% were tankless water heaters, and 6.5% were indirect-fired water heaters.

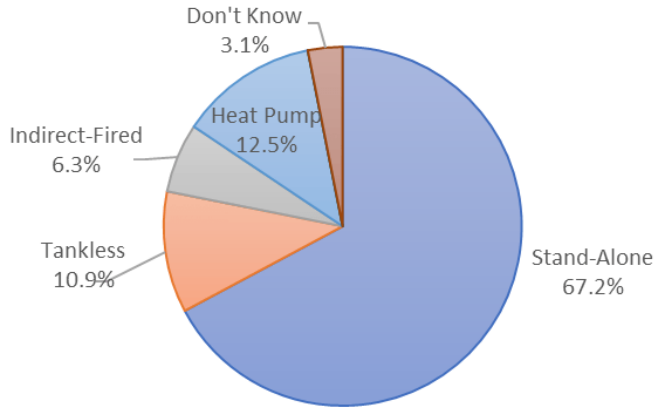
Figure 1-8 presents a breakdown of all water heating systems installed including supplemental units, not just the first water heating system in each home. As shown below in Figure 1-8 the majority (67.2%) of all water heating equipment in surveyed LIHEAP homes are stand-alone water heater tanks. GDS placed heat pump water heaters in a separate data category, and for this analysis did not include them in the "stand-alone" tank category of equipment. These stand-alone tanks are fueled by either electricity, oil or natural gas.

FIGURE 1-7 PRIMARY WATER HEATING EQUIPMENT BREAKDOWN



(Based on 62 water heating units)

FIGURE 1-8 WATER HEATING EQUIPMENT BREAKDOWN (PRIMARY & SUPPLEMENTAL)



Based on 64 water heating units – 62 primary units, 2 supplemental units)

Table 1-2 below shows a cross-tabulation of the fuel used for each type of water heating equipment for all observed water heating units. A key finding of this cross-tabulation is that stand-alone water heating tanks are fueled by electricity, oil or natural gas. The majority of all observed water heating units (48.4%) were electric stand-alone tank systems. Electric heat pump systems followed at 12.5%. Oil-fired units including stand-alone, tankless, indirect-fired, and heat pump systems accounted for an additional 20.4% of equipment types. Combined, natural gas and propane-fired systems accounted for 15.7% of units. No respondents had water heating units fired by kerosene, coal, wood, or other fuels- categories which were consequently excluded from Table 1-2. The three percentages provided in the chart below for each equipment type and fuel type from top to bottom are as follows: percentage of total water heating units, percentage of total equipment type in the row, and percentage of total fuel type in the column.

TABLE 1-2 BREAKDOWN OF ALL WATER HEATING SYSTEMS BY FUEL TYPE & EQUIPMENT TYPE (PRIMARY & SUPPLEMENTAL)

	Natural Gas		Electric		Propane		Oil		Don't Know		
	N	%	N	%	N	%	N	%	N	%	Total
Stand-Alone	2	3.1%	31	48.4%	4	6.3%	5	7.8%	1	1.6%	43
		4.7%		72.1%		9.3%		11.6%		2.3%	
		40.0%		77.5%		80.0%		38.5%		100.0%	
Tankless	2	3.1%	0	0.0%	0	0.0%	5	7.8%	0	0.0%	7
		28.6%		0.0%		0.0%		71.4%		0.0%	
		40.0%		0.0%		0.0%		38.5%		0.0%	
Indirect-Fired	1	1.6%	0	0.0%	0	0.0%	3	4.7%	0	0.0%	4
		25.0%		0.0%		0.0%		75.0%		0.0%	
		20.0%		0.0%		0.0%		23.1%		0.0%	
Heat Pump	0	0.0%	8	12.5%	0	0.0%	0	0.0%	0	0.0%	8
		0.0%		100.0%		0.0%		0.0%		0.0%	
		0.0%		20.0%		0.0%		0.0%		0.0%	
Solar	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0
		0.0%		0.0%		0.0%		0.0%		0.0%	
		0.0%		0.0%		0.0%		0.0%		0.0%	
Other	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0
		0.0%		0.0%		0.0%		0.0%		0.0%	
		0.0%		0.0%		0.0%		0.0%		0.0%	
Don't Know	0	0.0%	1	1.6%	1	1.6%	0	0.0%	0	0.0%	2
		0.0%		50.0%		33.3%		0.0%		0.0%	
		0.0%		2.5%		20.0%		0.0%		0.0%	
Cumulative Total	5		40		5		13		1		64

Note: The water heating equipment data in Table 1-2 is based on responses from 62 homes. Two of these 62 homes had 2 water heaters. GDS surveyors were not able to observe the type of water heaters or no water heaters were present for 6 homes.

1.2 LIGHTING AND APPLIANCES

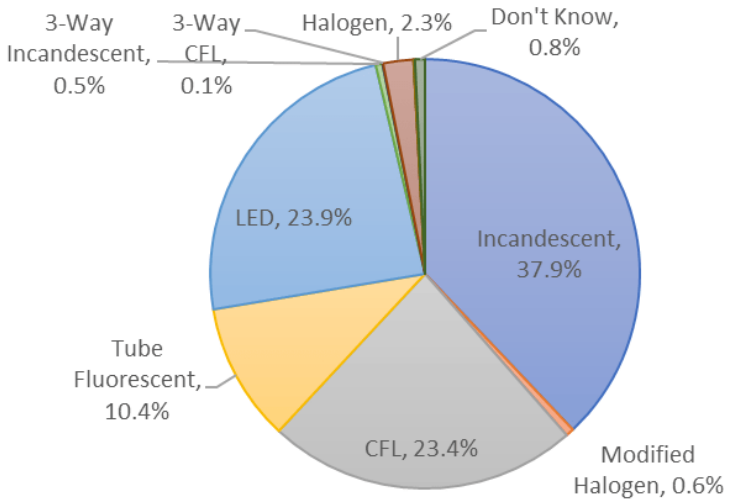
1.2.1 Interior Lighting

GDS on-site surveyors found a total of 1,980 light bulb sockets in the interior of the 68 low-income homes surveyed. Only 5 of the 1,980 sockets did not have a light bulb installed. The type of light bulb installed could not be identified for 13 sockets. On average, Maine's low-income homes have 29.1 interior light bulb sockets per home. The average number of installed interior light bulbs is 29.0 light bulbs per low-income home.

In these 68 low-income homes, incandescent bulbs are still the most prevalent type of interior light bulb, with a count of 749 regular incandescent bulbs and 10 three-way incandescent bulbs. Regular incandescent and three-way incandescent bulbs were installed in 38.3% of all interior sockets found on-site. Light Emitting Diode (LED) bulbs were installed in 23.9% of sockets. Compact Fluorescent Lights (CFLs) are installed in 23.4% of sockets. Together LEDs (23.9%) and CFLs (23.4%) account for 47.3% of interior bulbs in LIHEAP homes. The 2018 saturation of LED bulbs of 23.9% in the interior of low-income homes is significantly higher than the 2015 saturation of LED bulbs of 9% for all single-family homes.

Seventy-seven percent (76.5%) of LIHEAP homes have at least one LED bulb in the interior of the house, and 29.4% have at least one LED bulb for exterior lighting. Figure 1-9 and Table 7-1 (see Section 7) show the breakdown of interior light bulbs by type of bulb. Regular (not three-way) incandescent bulbs represent 37.9% of total interior bulbs, the highest share of any bulb type.

FIGURE 1-9 INTERIOR BULB TYPE



(Based on 68 completed surveys)

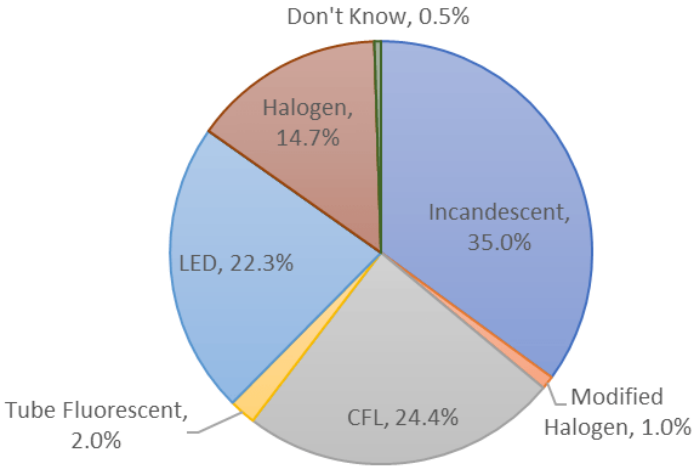
1.2.2 Exterior Lighting

GDS on-site surveyors found a total of 197 exterior light bulbs in the 68 low-income homes surveyed. All the 197 exterior sockets observed had a light bulb installed. The type of light bulb installed could not be identified for 1 socket. On average, Maine's low-income homes have 2.9 exterior light bulb sockets with a bulb per home.

In these 68 low-income homes, incandescent bulbs are still the most prevalent type of exterior bulb, with a count of 69 regular incandescent bulbs and no three-way incandescent bulbs. Incandescent bulbs are installed in 35.0% of all exterior sockets found on-site- the highest share of any bulb type. LED bulbs are installed in 22.3% of exterior sockets. CFLs are installed in 24.4% of exterior sockets. Together LEDs (22.3%) and CFLs (24.4%) account for 46.7%

of exterior bulbs in LIHEAP homes. Figure 1-10 and Table 7-3 (see Section 7) show the breakdown of exterior light bulbs by type of bulb.

FIGURE 1-10 EXTERIOR BULB TYPE

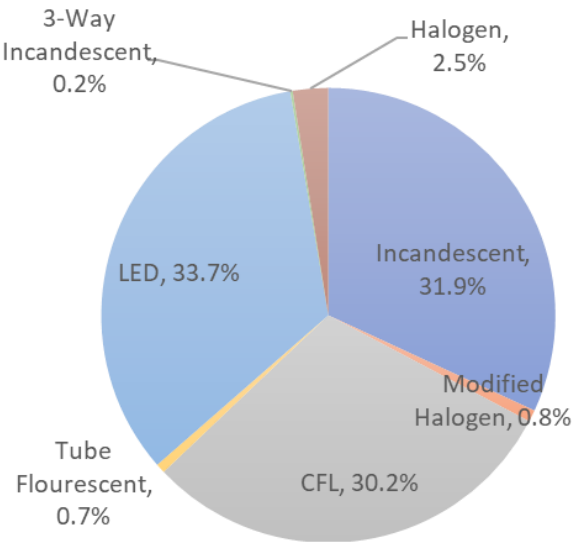


(Based on 68 completed surveys)

1.2.3 Light Bulbs in Storage

Figure 1-11 and Table 7-4 (see Section 7) display information on the 596 bulbs in storage in the 68 homes surveyed. Approximately a third of bulbs in storage (33.7%) were LED bulbs, followed by incandescent bulbs (31.9%), CFL bulbs (30.2%), and halogen bulbs (2.5%). Combined, tube fluorescent, modified halogen, and three-way incandescent bulbs accounted for 1.7% of all bulbs in storage.

FIGURE 1-11 BULB TYPES IN STORAGE



(Based on 68 completed surveys)

Table 7-4 in Section 7 of this report displays bulb type data collected from the 68 surveyed homes on the 596 bulbs in storage from the 2015 statewide study.

1.2.4 Hours of Use for Residential Lighting in Low-Income Homes

GDS installed up to seven Dent light loggers in the 68 surveyed low-income homes in Maine. Each light logger was left in place for an average of 49 days and recorded detailed information on when lights were on and off. The light loggers were installed at random near light bulbs in up to six main living areas in the interior of each home (kitchen, living room, dining room, bedrooms, hallways, etc.) and at least one exterior light bulb location. After several weeks GDS retrieved the light loggers and down loaded the light logger data for statistical analysis. The average daily hours of use for interior lighting in low-income homes is 3 hours. The average daily hours of use for exterior lighting for the surveyed low-income homes is 3.60 hours. The overall summer coincidence factor at the time of the ISO-NE electric system peak in Maine in the summer on a weekday afternoon is 0.132.[10] The overall winter coincidence factor is 0.138 at the time of the ISO-NE electric system peak in Maine in the winter on a weekday afternoon. [11]

The average daily hours of use information for the residential lighting end-use can be used along with light bulb wattage information to calculate the annual kWh savings that can be achieved by replacing incandescent bulbs with LED bulbs. The residential lighting coincidence factor represents the percentage of light bulbs that are on at the time of the summer or winter peak electric demand. The coincidence factor information can be used along with light bulb wattage information to calculate peak demand reductions that can be achieved during peak load hours in the summer and winter.

Section 7 of this report provides more detailed information about the light logger data collected for these 68 homes.

1.2.5 Insulation in Exterior Walls, Attics, Frame-Floors & Heating Ducts

Using special Testo electronic measurement equipment, GDS on-site surveyors measured insulation R-values for exterior walls in 60 of the 68 surveyed homes. The average R-value for walls with existing insulation surveyed homes was R-10, substantially below the recommended wall insulation guideline for Maine homes of R-29 and below the 2015 baseline study level of R-13. Thirty-six of the 68 surveyed homes (52.9%) had exterior wall insulation with R values of less than R-10.

As shown in Table 8-1 (see Section 8), the average R-value of observed attic insulation in the 68 surveyed homes was determined to be R-30, slightly above the level observed in 2015 baseline study. Five out of 68 homes (7.4%) had no observable attic insulation present. Surveyors were unable to assess whether attic insulation was present in 13 out of 68 homes (19.1%).

The average R-value of insulation for frame floors over unheated basements in surveyed homes with insulation present was determined to be R-17 and that of insulation for foundation walls in heated space was R-16. When homes meeting the criteria, but without insulation present are included in these calculations, the average R-value drops significantly to R-4 for homes with frame floors over unheated basements and R--3 for homes with foundation wall insulation in heated basements.[12]

[10] A coincidence factor of .132 means that 13.2% of interior residential light bulbs were on at the time of the summer peak load hour in New England.

[11] GDS obtained historical data on the dates and times of summer and winter peak loads in Maine from: https://www.iso-ne.com/search?query=maine%20peak%20load.

[12] GDS did not have access to the method used in the 2015 statewide study to calculate the 2015 baseline data for the average R-value for frame floors over unheated basements and the average R-value for foundation walls in heated space. The floor R-values presented in this sentence are for homes having floor insulation only.

1.2.6 Appliance Saturation & Comparisons with ENERGY STAR Standards

GDS collected detailed information on the saturation and ENERGY STAR certification status of various appliances found in the 68 surveyed LIHEAP homes for the purpose of identifying high impact areas for appliance energy efficiency improvements.

Table 1-3 displays the appliance saturation of select appliances in decreasing order, the corresponding percentages of homes with at least one of each appliance in the 68 surveyed LIHEAP homes and the percentage of all Maine single-family homes with at least one of each appliance. Appliances in the 2015 baseline study where data on percentages of homes with at least one appliance are available are included in Table 1-3. Additional appliances beyond those surveyed in 2015 have been included to present information on appliances with the highest appliance saturations.

TABLE 1-3 SATURATION OF SELECT APPLIANCES

Appliance	2015 Statewide Study - % Home with at Least One	2018 LIHEAP Study - % Homes with at Least One	2018 LIHEAP Study - Appliance Saturation
Television	-	97%	226%
Cell Phone Charger	-	78%	181%
Refrigerator	100%	100%	114%
DVD/Blu-Ray	-	69%	94%
Clothes Washer	52%	89%	89%
Clothes Dryer	35%	85%	85%
Freezer	57%	47%	55%
Dishwasher	54%	49%	49%
Dehumidifier	28%	20%	28%

Table 10-37 (see Section 10) provides information on the number of various appliances observed in surveyed LIHEAP homes and the percentage of these appliances that met 2018 ENERGY STAR criteria. Of the refrigerators, freezers, clothes washers, clothes dryers, dehumidifiers, dishwashers, air purifiers, and humidifiers found in the 68 surveyed homes, no appliances met 2018 ENERGY STAR standards.

Seventeen percent of all freezers, 17% of air purifiers, and 10% of humidifiers observed in surveyed homes were reported to meet ENERGY STAR standards at the time of appliance manufacture.

The ENERGY STAR certification of appliances for which a 2015 baseline was available included clothes washers (32%), clothes dryers (4%), and dishwashers (18%). In the 68 low-income homes surveyed in 2018, no clothes washers, clothes dryers, or dishwashers observed met 2018 ENERGY STAR criteria or ENERGY STAR criteria at any point in time.

2 Methodology

2.1 STUDY PARAMETERS

GDS performed the 68 on-site surveys of low-income households from February to June 2018 to collect detailed and accurate inventories of residential structure and equipment characteristics throughout Maine. This study captured a variety of energy-related data, including the penetration of electric and non-electric equipment and appliances, energy efficiency levels of energy-using equipment and appliances, building shell characteristics, lighting socket counts, energy used for transportation, and other relevant information. GDS also used specific electronic measurement equipment to assess the wall insulation R-value level in each surveyed LIHEAP home. GDS also installed up to seven electronic light loggers in surveyed homes to measure the hours of use of lighting in various types of rooms in each home (i.e., kitchen, living room, dining room, bedrooms, bathrooms, hallways, etc.). All the housing characteristics and energy using equipment data presented in this report were collected by trained GDS surveyors through on-site surveys. None of the survey data was collected by telephone surveys, web-based, email or mail surveys

A total of 68 on-site surveys stratified by geographic region of Maine were completed. The desired level of precision for study results, ±10% absolute precision, with 90% statistical level of confidence, necessitated a total of 68 completed on-site visits to randomly selected low-income households in Maine. This target was rounded to 70 for the final sampling plan. The individual on-site survey data were input into an electronic database and then aggregated to the statewide level using SAS, a statistical analysis software package [13]. The sample size was not large enough, nor was it intended to provide housing sub-segment specific results within each electric distribution company (EDC) at the 90% level of confidence and 10% margin of error.

Figure 2-1 shows the locations of the 68 surveyed homes that participated in this research study. The sampling plan was designed to ensure that the number of survey participants from Northern, Central and Southern Maine is representative of all Maine low-income households that participate in Maine's Low-Income Home Energy Assistance Program (LIHEAP) and are responsible for paying their home heating bill.

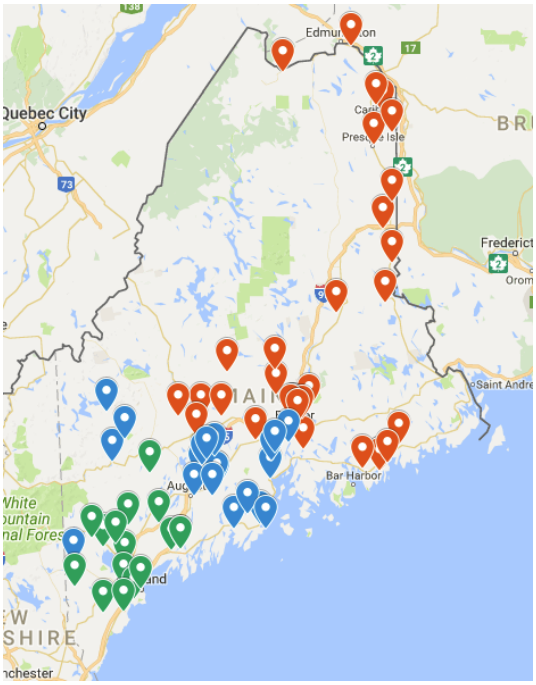


FIGURE 2-1 GEOGRAPHICAL LOCATIONS OF SURVEY PARTICIPANTS

2.2 SELECTION OF RANDOM SAMPLE

The target precision and statistical confidence level for this baseline study of low-income homes in Maine was ±10% precision at the 90% level of confidence. To achieve this desired level of precision, a minimum sample size of 68 was required across the state. To ensure proper representation, the sample was designed to include a representative cross-section of residential low-income households in Maine.

GDS worked closely with staff of the Maine OPA, the Efficiency Maine Trust, and Synapse Energy Economics during the fall of 2017 to develop the sample design for this study. This group met in-person at the Maine OPA offices in September 2017 to discuss the sampling approach, data sources that could

[13] For more detailed information about this software package, see the SAS website at www.sas.com.

be used to identify low-income households in Maine and the need to select a random sample of low-income households that matched the established eligibility requirements for participation in low-income energy efficiency programs offered by Efficiency Maine. This group of planners reviewed data on Maine low-income population characteristics based on statistics from the latest U.S. Bureau of the Census American Community Survey [14] for Maine and data on participants in Maine's LIHEAP program. The study planners were also uncertain that utility datasets identifying low-income qualified customers were either available or could be provided to GDS. After reviewing and discussing data availability and reliability, it was decided collaboratively by the study design group that GDS would select a stratified random sample of approximately 1,200 records from Maine's LIHEAP database of 38,322 participants. From this sample GDS established a target goal of 70 completed on-site surveys.[15] For comparison purposes, the total number of low-income households in Maine in 2018 is estimated by the Maine Department of Health and Human Services to be 175,924 households. [16] According to the U.S. Bureau QuickFacts for Maine, there are 551,109 households [17] in total in Maine. Thus, 32 percent of households in Maine are low-income households.

During the development of the sampling plan for this study, the study design group did discuss and examine potential sources of bias that could result from the use of the LIHEAP database as the population frame from which to select a random sample. ***Appendix F*** provides a copy of a memo to the study design group prepared by GDS in the fall of 2017 that compared key characteristics of the Maine LIHEAP population to similar data from the latest U.S. Bureau of the Census American Community Survey. This comparison showed that household characteristics of the LIHEAP population are very similar to the data for low-income households in the American Community Survey. In brief, the study design group did not identify any sources of bias that were a concern given that Efficiency Maine programs consider LIHEAP eligibility criteria[18] for its low-income energy efficiency programs. Furthermore, few characteristic differences were found between Maine's Low-Income qualified population and Maine's LIHEAP population. Last, the sample design used was stratified with quotas for 70 subgroups to ensure that the completed surveys would be representative of the overall population of LIHEAP participants in Maine. The study design group concluded that using the LIHEAP database as the population frame from which to select a random sample was the best course of action for the study design.

It was necessary to select a random sample several times larger than the target sample of completed surveys to allow for the fact that not all households are interested or available. Listed below are the factors which may prevent a household from participating:

1 Mailing address or phone number in the LIHEAP database no longer valid

[14] American Community Survey 5-Year statistics are available by state. GDS developed estimates of the LI-qualified population in Maine by county using the reported data. In addition, a subset of the complete ACS dataset, the Public Use Microdata Set (PUMS) was also available. GDS developed additional crosstabs of LI-qualified housing in Maine by housing type and fuel type using the ACS PUMS dataset.

[15] The study planners selected the Maine LIHEAP database as the "population" of Low-Income qualified households in Maine. GDS, OPA and Efficiency Maine Trust staff reached consensus that the sample should represent low-income homes that are eligible to participate in Efficiency Maine low-income programs. Efficiency Maine Trust low-income programs are limited to "means tested" participants. Since Efficiency Maine does not directly verify income status, LIHEAP eligibility adequately addresses this requirement. As such, all Maine LIHEAP participants are eligible to participate in the Efficiency Maine Trust low-income programs. Maine LIHEAP income eligibility is consistent with 150% of the federal poverty level and below.

[16] The count of low-income households in Maine was provided to GDS by Sapan Panchal, Consultant to the Maine DHHS, via email on July 19, 2018.

[17] See https://census.gov/quickfacts/fact/table/me/PST045217

[18] The Efficiency Maine web site states that participation in Maine's LIHEAP program is one of the factors considered when determining eligibility for Efficiency Maine programs for low-income households.

2 Voice mailbox for home phone or cell phone not set up or is full

3 Phone busy when phone call was made to household

4 LIHEAP participant had moved locations since the date the LIHEAP database was provided to GDS

5 Household not interested in participating

6 On-site survey cancelled by household due to major blizzards that hit Maine in the winter of 2018

Although all low-income residents affected could benefit from improvements to indoor environmental quality resulting from the implemented program, the planners of this study (GDS, Maine OPA and Efficiency Maine Trust staff) were concerned regarding the participation of low-income qualified residences that do not pay for their own heat or electricity that would not directly benefit from potentially reduced utility bills. Consequently, low-income qualified households that do not pay for their heating and/or electricity were removed from the analysis. Before selecting the random sample of this study from the LIHEAP database, GDS removed records that were identified as ***(a)*** not having an electricity account and ***(b)*** home ownership status was recognized as "rent with heat" or "subsidized with heat." GDS removed 6,961 households (18 percent of the LIHEAP database records) from the former category and 4,202 households (11 percent of the LIHEAP database records) from the latter category.

2.3 RECRUITMENT OF STUDY PARTICIPANTS

The first step in the survey process was to design a letter to inform customers included in the initial recruitment sample that an energy efficiency baseline survey was to be performed in Maine by the Maine OPA and direct them to enroll in the study by phone or internet sign-up if the household was interested in participating. The primary recruitment letter was sent out under the name and letterhead of the Maine OPA.[19] Next, a phone recruitment script was designed for use by GDS staff when speaking with households that contacted GDS by phone or the internet to enroll in the study. This script introduced the study to inquiring households, explained the process and demands of the on-site survey, and requested participation. To facilitate recruitment, GDS offered a $50 incentive to homeowners willing to participate in and complete the survey. GDS also offered to conduct surveys in the evenings or on weekends to eliminate any dropout bias from those who could not be available during weekday or daytime hours.

To ensure that the random sample was representative of the geographic and housing type distribution of low-income homes across the State, GDS sorted the sample of 1,200 residences into 70 select bins. Once one household in a bin agreed to the on-site survey, the GDS team initially did not actively recruit the remaining residences in that bin. This helped to ensure that a final on-site sample continued to be stratified by geographic region of the state and by housing type. In a few instances where there were no homeowners within a bin that were willing or able to participate in the study, recruiters enlisted a residential customer from a neighboring bin. For those customers where the LIHEAP database had phone numbers, GDS attempted to contact those customers by phone or by mailed postcard at least four times prior to considering an account not part of the study. The breakdown of the geographic location and housing type distribution of the 68 participants compared to the LIHEAP population is provided in later sections of this report. GDS was successful in recruiting survey participants from 58 of the 70 bins. The breakdown of bin utilization is as follows: 50 bins with one survey participant, 6 bins with two survey participants, and 2 bins with three survey participants.[20] Because all LIHEAP participants in the sample of approximately 1,200 homes were selected at random for this study, and because the 68 responding homes match

[19] A sample copy of the initial recruitment letter is provided in Appendix B.

[20] The overall population of LIHEAP program participants is distributed as follows: 46% in Northern Maine; 31% in Central Maine, and 23% in Southern Maine. The 68 homes surveyed in this study are distributed in the same percentages, as follows: 46% in Northern Maine, 31% in Central Maine and 23% in Southern Maine.

the geographic, type of housing, primary space heating fuel and other characteristics of the overall population of LIHEAP participants, the study results are not biased by not having representation from 12 of the 70 bins.

2.3.1 Mail Recruiting

The primary method for recruiting study participants was via mail. In January, GDS mailed a first-class letter from the OPA to recruit study participants. A copy of this recruitment letter is provided in ***Appendix B***. GDS then mailed follow-up postcards from the OPA to the recruitment sample every few weeks to encourage interested Maine households to enroll in the survey by contacting GDS by phone or through the GDS website. A copy of the follow-up postcard is provided in ***Appendix C***. Eighteen participants were recruited after completion of an online form whose web address was provided in mailed recruiting letters and follow-up postcards.

2.3.2 Incoming Telephone Recruiting

As discussed above, the initial recruiting letter invited low-income households to call the 800-toll-free number in the letter or sign-up via the internet to enroll in the on-site survey research. GDS prepared a telephone recruitment script for use when speaking with households that contacted GDS by phone or the internet to enroll in the study. This script introduced the study to inquiring households, explained the process and requirements of the on-site survey, and asked for participation. A copy of the phone recruiting script for incoming phone or internet inquiries is provided in ***Appendix D***. Thirty-seven participants were recruited through incoming calls to an 800-toll-free number provided in mailed recruited letters and follow-up postcards.

2.3.3 Out-Going Telephone Recruiting

The LIHEAP database provided phone numbers and email addresses for approximately 40% of the households in the recruitment sample. GDS staff made out-going phone calls to households with phone numbers and recruited some of the study participants by phone. The recruitment by phone calls was in addition to the recruitment done via mail that is described below. Phone calls were made to households in the random sample about one to two weeks after the initial recruitment letter was mailed. It is important to note that the LIHEAP database provided to GDS by the Efficiency Maine Trust did not provide a phone number for 60% of the LIHEAP households, and many of the phone numbers provided had been disconnected or were not correct. Thirteen participants were recruited during outgoing phone calls. A copy of the phone recruiting script for out-going recruiting by phone is provided in ***Appendix E***.

2.3.4 Web-Based Enrollment

The initial recruiting letter and the three follow-up postcards were mailed to the random sample and encouraged interested households to contact GDS through a portal for this specific study set up by GDS on its public website. Most of the study participants enrolled in the study using this web-based portal.

2.4 ON-SITE DATA COLLECTION

By using an on-site survey instrument and trained staff to collect quantitative data on energy-using equipment and housing characteristics, the data collected has a higher level of accuracy compared to a survey based on self-reported data collected by phone. Information collected via phone included confirmation of the selected primary contact's official position, phone number, email address, service address, type of commercial building, and number of buildings at the service address. All other information collected in this study including equipment saturation, energy efficiency rating, and fuel type were collected through visual observation of the site surveyor. Light loggers were installed on a sample of up to seven randomly selected lightbulbs in each home to collect data on hours of use of household lighting. For the overall sample of 68 homes, 449 light loggers were installed, left in place for an average of 49 days, and were successfully retrieved from participating homes.

Special Testo measurement equipment was used to measure the R-value of wall insulation levels at each home. To maximize the effectiveness of each on-site visit and provide results with a high level of detail, GDS designed the on-site survey to be as comprehensive as possible without being overly intrusive to the homeowner. In addition, the on-site survey form was generally consistent with the survey forms used by GDS for similar baseline studies completed in 2011 and 2014 for the Pennsylvania Public Utility Commission. Last, the survey form was reviewed by staff of the OPA and the Efficiency Maine Trust and their comments on the survey were addressed before the survey form was finalized. The final version of the on-site survey instrument is provided in ***Appendix A***.

The on-site surveys were completed by four trained site surveyors during the period from February through June 2018. In total 68 on-site surveys were completed by GDS. Surveyors were typically able to complete each survey and the U-value measurement within a two- to three-hour window (excluding the time to travel to and from each site from a central location). Installation of up to 7 light loggers in each home took an additional 30 to 45 minutes per home.

2.4.1 End Uses

The study categorizes energy using equipment into appropriate end-uses. The types of energy end-uses included in this report are consistent with those typically considered in other state, regional, or national energy efficiency baseline studies. The residential end-uses examined in this study are:

- ***Building Envelope***
- ***Space Heating Equipment***
- ***Space Cooling Equipment***
- ***Water Heating***
- ***Lighting***
- ***Major Appliances***
- ***Consumer Electronics (plug loads)***
- ***Transportation***
- ***Other***

2.5 DATA VALIDATION AND ANALYSIS

2.5.1 Data Validation and Review

GDS completed a review of the collected data for validity and completeness to ensure data quality across all responses. All fields were scanned for data entry errors as well as outliers. Then GDS corrected any errors. In addition to data entry errors, GDS checked internal consistency in recorded responses across data 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 applicable.

In addition, during the month of June 2018, GDS reviewed missing or outlier data points that GDS identified and conducted follow-up with our surveyors and survey participants to obtain clarification of data where needed. GDS also used publicly available data sources, such as public property records, to complete additional corrections and refinements of the data collected. Finally, GDS used the make/model numbers of various appliances and HVAC equipment recorded during the on-site surveys to determine their energy efficiency levels. This secondary research improved the accuracy of survey data relating to the energy efficiency level of appliances and energy-using equipment.

2.5.2 Weighting Factors

Given the different characteristics between single family, multifamily, and manufactured homes, GDS developed case weights that could be used if necessary to control for sample bias. Specifically, we calculated sample weights by post-stratifying the sample by building type. The case weights 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

For this report, GDS has not applied the case weights as the characteristics of the households where the on-site surveys were completed are very similar to the population of low -income households in Maine. Table 3-4 in Section 3 shows that the type of housing (single-family, multi-family, manufactured or mobile home) for homes included in the Maine OPA baseline survey is very similar to the distribution of the total population of LIHEAP homes in Maine that are responsible for paying bills for their home heating fuels.

2.5.3 Penetration vs. Saturation

This report frequently cites two metrics: appliance 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 have a penetration of 86% in Maine's low-income households. This means 86% of all low-income homes in Maine have at least one PC (though they could have more than one).

Saturation refers to the number of a 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 appliance penetration because some households will have more than one of the appliances (except lighting).[21] For instance, a computer saturation of 156% in Maine indicates that, on average, there are 1.56 computers in residential low-income households in Maine, on average.

While saturation indicates 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 above, while the saturation of computers is 156%, only 86% of the 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.

2.6 UNCERTAINTY

The survey estimates presented in this report are subject to a certain degree of uncertainty. Practical constraints make it impossible for the Maine OPA to fund a study to conduct an on-site survey for the entire population of Maine low-income households or even all 38,300 participants in Maine's LIHEAP program, 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 90% and 10%, respectively, for the state-wide residential sector. This means that if this study were repeated multiple times,

[21] 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.

90% of the studies would produce estimates to within ±10% of the true population value. The sample size required to achieve these levels of confidence with a large population is given in Equation 2-1.

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

EQUATION 2-1 SAMPLE SIZE DETERMINATION

Where:
n = Sample size
Z = Value for selected confidence level. A confidence level of 90% corresponds to a Z value of 1.64
p = Expected proportion of responses. Maximum possible proportion of 0.5 yields maximum sample size
d = Margin of error, ± 0.10

Based on this equation, the minimum sample size required to achieve precisions of ±10%, at a 90% confidence level, is 68. The targeted sample size of 70 customers is sufficiently large to achieve this level of confidence. As can be shown by the equation above, a sample size greater than 68 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.

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. For these instances, an "Unknown" field was specified. GDS has included "Unknown" responses in our analysis where meaningful; otherwise, we present the percentages after eliminating these unknown responses. GDS 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. Though stratified samples were selected randomly, it is possible that the sample contains some type of bias which can influence results. GDS verified that the residential sample was consistent with population level data across a variety of data variables (geographic region of the state, housing type, heating fuel, etc.), but notes that differences between the sample and population could still exist.

Where possible, GDS took steps to ensure biases were minimized in the sample given the time and budget constraints allotted. The sample of 1,200 low-income homes was selected randomly from the Maine LIHEAP database in a manner which eliminated the potential for human error or other biases. GDS stratified the recruitment sample to calibrate the target of 70 completed on-site surveys based on a known mix of housing types and geographic location. GDS attempted to minimize the potential for systematic uncertainty through consistent surveyor training and data collection methods. By taking these steps, the GDS team believes that the results of the survey can be used to make reasonable assumptions about the characteristics of the overall Maine LIHEAP population (those LIHEAP participants responsible for paying their electric bills), which is the focus of this study.

3 General Home Characteristics

This section of the report compares general home characteristics of the 68 surveyed LIHEAP households to the general population of all residential households in Maine. Data on the general population of Maine single-family households was obtained from the September 2015 "Maine Single-Family Residential Baseline Study" published by Efficiency Maine. It is important to note that a trained GDS surveyor collected all of housing characteristics and energy using equipment information through an on-site visit to each of the 68 surveyed homes. GDS made telephone, mail and email contacts with LIHEAP participants in the random sample solely for the purpose of recruiting them for participation in the on-site surveys.

The main differences between the surveyed LIHEAP households from all Maine single-family households are the following:

1. The surveyed Maine LIHEAP houses have an average age of 65 years, compared to 58 years for all Maine single-family households. (Note, the age data reported here is for the age of the structure, not the age of the survey respondent.)
2. Forty-one percent (41.2%) of surveyed Maine LIHEAP households have only one person per household. This compares to a figure of 12% of all Maine single-family households from the 2015 statewide study. The average persons per household for the 68 homes surveyed in this baseline study is 2.2 versus 2.5 for all single-family homes in Maine. Thus, the number of persons per household for the LIHEAP households is different than for all of Maine's single-family households.
3. The majority of surveyed households (61.8%) were single-family homes, 27.9% of surveyed homes were mobile homes, 7.4% of surveyed homes were multi-family homes, and the remaining 2.9% were townhouse homes. The 2015 Maine Single-Family Residential Baseline Study included only single-family homes.
4. Fifty-three percent (52.9%) of surveyed LIHEAP homes have a programmable thermostat as compared to 39% for all Maine single-family homes.
5. The surveyed LIHEAP households keep their homes warmer than all single-family homes in Maine during the day in the winter. The surveyed LIHEAP households keep their homes cooler than all single-family homes in Maine during the day in the summer.
6. Low-income housing has a greater proportion of multi-family and manufactured/mobile homes.

When available, the data in Tables 3-1 to 3-10 presents comparisons of the characteristics of Maine low-income households to all single-family households in Maine.

TABLE 3-1 REPORTED ELECTRIC DISTRIBUTION COMPANY

Electric Distribution Company	Frequency	Percent of Total
Central Maine Power	42	61.8%
Emera	23	33.8%
Eastern Maine Electric Cooperative	2	2.9%
Other	1	1.5%
Total Responses	**68**	**100.0%**

TABLE 3-2 YEAR OF HOUSEHOLD CONSTRUCTION

Year Constructed	Frequency	Percent of Total
1700-1799	1	1.5%
1800-1849	2	2.9%
1850-1899	4	5.9%
1900-1909	3	4.4%
1910-1919	2	2.9%
1920-1929	4	5.9%
1930-1939	3	4.4%
1940-1949	2	2.9%
1950-1959	7	10.3%
1960-1969	3	4.4%
1970-1979	11	16.2%
1980-1989	10	14.7%
1990-1999	5	7.4%
2000-2009	7	10.3%
2010 or Later	1	1.5%
Don't Know	3	4.4%
Total Responses	**68**	**100.0%**

TABLE 3-3 AVERAGE AGE OF HOMES SURVEYED

	2015 Statewide Study of Single-Family Homes	2018 LIHEAP Study
Average age of home (Years)	58	65
Median age of home (Years)	N/A	48
Total Responses	**41**	**68**

TABLE 3-4 PERSONS PER HOUSEHOLD

Number of People Living in household	2015 Statewide Study *(Number of Households)*	2015 Statewide Study *(% of Total)*	2018 LIHEAP Study *(Number of Households)*	2018 LIHEAP Study *(Percent of Total)*
1	5	12.0%	28	41.2%
2	21	52.0%	22	32.4%
3 - 4	11	28.0%	12	17.6%
5 - 6	3	8.0%	5	7.4%
7+	0	0.0%	1	1.5%
Average Persons per Household	**2.5**		**2.2**	
Total Responses	**41**	**100.0%**	**68**	**100.0%**

TABLE 3-5 WEEKS PER YEAR HOUSEHOLD OCCUPIED

Number of Weeks	Frequency
52	67

TABLE 3-6 AGE DISTRIBUTION OF SURVEY RESPONDENTS OF HEAD OF HOUSEHOLD

Age Group	2015 Statewide Study *(Respondent's Age)*	Percent of Total	Age Group	2018 LIHEAP Study *(Head of Household's Age)*	Percent of Total
15-34	1	2.0%	15-24	1	1.5%
			25-44	8	11.8%
35-64	24	59.8%	45-54	18	26.5%
			55-64	23	33.8%
65+	14	35.3%	65+	18	26.5%
Refused	1	2.9%	Refused	0	0.0%
Total Responses	**40**	**100.0%**	**Total**	**68**	**100.0%**

TABLE 3-7 HIGHEST LEVEL OF EDUCATION ACHIEVED BY HEAD OF HOUSEHOLD

Education Level	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Less than High School Diploma	9	13.4%	9	13.4%
High School Diploma or Equivalent	29	43.3%	38	56.7%
Some College, No Degree	11	16.4%	49	73.1%
Associate's Degree	9	13.4%	58	86.6%
Bachelor's Degree	6	9.0%	64	95.5%
Graduate Degree or Higher	3	4.5%	67	100.0%

TABLE 3-8 PARTY RESPONSIBLE FOR UTILITY BILL

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Head of Household	65	95.6%	65	95.6%
Someone Else	3	4.4%	68	100.0%

TABLE 3-9 COMPARISON OF BREAKDOWN OF HOUSING TYPE

2015 Statewide Study, U.S. Census, All LIHEAP Participants, and 2018 Maine OPA Baseline Study

Type of Housing	2015 Statewide Study	U.S. Census Data for Maine Low-Income Households	2017 Data on Maine LIHEAP Households	2018 LIHEAP Study	
	%	%	%	Frequency	%
Single Family	86%	71.5%	56.1%	42	61.8%
Townhouse/Duplex	3%	0%	0%	2	2.9%
Multifamily (2 or more units)	-	5.6%	12.7%	5	7.4%
Manufactured/Mobile Home	11%	22.9%	31.2%	19	27.9%
Total	**100%**	**100.0%**	**100.0%**	**68**	**100.0%**

TABLE 3-10 TYPE OF THERMOSTAT

	2015 Statewide Study	2018 LIHEAP Study
Manual Thermostat Only	25 (61%)	29 (42.6%)
Programmable Only	16 (39%)	36 (52.9%)
Don't Know	-	2 (2.9%)
Not Applicable	-	1 (1.5%)
Total Responses	**41 (100%)**	**68 (100.0%)**

TABLE 3-11 WINTER THERMOSTAT SET POINTS

	2015 Statewide Study		2018 LIHEAP Study	
Age	Day	Night	Day	Night
Average	66	64	68	66
Minimum	50	50	50	33
Maximum	72	72	78	78
Total Responses	**46**	**46**	**66**	**66***

* Two of the 68 respondents did not report winter temperature settings

Table 3-7 provides 2018 data for summer thermostat set points only for the three homes that have central air conditioning systems of the total 68 surveyed homes.

TABLE 3-12 SUMMER THERMOSTAT SET POINTS

	2015 Statewide Study		2018 LIHEAP Study	
Age	Day	Night	Day	Night
Average	75	73	69.3	70
Minimum	70	68	68	70
Maximum	80	76	70	70
Number of Responses	10	10	3	3

TABLE 3-13 HAS A REFRIGERATOR BEEN REMOVED FROM THE HOME IN THE PAST FIVE YEARS

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Yes	17	25.0%	17	25.0%
No	51	75.0%	68	100.0%

TABLE 3-14 IF A REFRIGERATOR HAS BEEN REMOVED FROM THE HOME IN THE PAST FIVE YEARS, WHAT WAS DONE WITH REFRIGERATOR

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Landfill	6	35.3%	6	35.3%
Sold	1	5.9%	7	41.2%
Picked up by Retailer	4	23.5%	11	64.7%
Recycled by Utility	1	5.9%	12	70.6%
Donated	2	11.8%	14	82.4%
Other	3	17.6%	17	100.0%

TABLE 3-15 IF A REFRIGERATOR HAS BEEN REMOVED FROM THE HOME IN THE PAST FIVE YEARS, WAS IT REPLACED

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Yes	17	100.0%	17	100.0%

TABLE 3-16 HAS A FREEZER HAS BEEN REMOVED FROM THE HOME IN THE PAST FIVE YEARS

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Yes	9	15.3%	9	15.3%
No	50	84.7%	59	100.0%

TABLE 3-17 IF A FREEZER HAS BEEN REMOVED FROM THE HOME IN THE PAST FIVE YEARS, WHAT WAS DONE WITH FREEZER

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Landfill	4	44.4%	4	44.4%
Sold	0	0.0%	4	44.4%
Picked up by Retailer	2	22.2%	6	66.7%
Recycled by Utility	1	11.1%	7	77.8%
Donated	2	22.2%	9	100.0%

TABLE 3-18 IF A FREEZER BEEN REMOVED FROM THE HOME IN THE PAST FIVE YEARS, WAS IT REPLACED

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Yes	6	66.7%	6	66.7%
No	2	22.2%	8	88.9%
No Response	1	11.1%	9	100.0%

Table 3-19 below displays the frequency of energy audits in surveyed homes. Sixty-eight percent (67.7%) of respondents reported the home had never been audited with 29.4% of respondents reporting energy auditing had taken place in the past. [22] Only 3% of respondents did not respond or did not know.

TABLE 3-19 ENERGY AUDIT HISTORY

Previous Energy Audit	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Yes	20	29.4%	20	29.4%
No	46	67.7%	66	97.1%
No Response/Don't Know	2	2.9%	68	100%

[22] Upon comparison with the general homeowner population, the observed incidence of energy audits in surveyed homes (29.4%) is significantly higher than the incidence expected by Efficiency Maine Trust staff. This raises the possibility that the survey respondent group may differ in key characteristics from the general population of LIHEAP participants. It is possible that the low-income households that volunteered to participate in this baseline study are more likely to install energy efficiency measures and participate in energy audits than households that did not volunteer to participate in this study. This phenomenon is known as "self-selection bias". GDS notes, however, that the geographic distribution, type of housing (single-family), multi-family, or mobile home), primary fuel for space heating and other characteristics of the 68 surveyed homes are almost identical to statistics for the total population of LIHEAP homes in Maine.

4 Space Heating Fuels & Equipment

This section of the report provides data on heating fuels and equipment in the 68 Maine LIHEAP households participating in this study. The data tables in this section provide a comparison of space heating fuel and heating equipment data for the 68 LIHEAP households surveyed in 2018 to the general population of all single-family residential households in Maine based on 2015 survey data. The term "space heating equipment" refers to the furnaces, boilers, heat pumps, wood stoves and other equipment used to heat homes. The detailed information provided in this section about the primary fuels and type of equipment used by low-income homes in Maine for space heating is very useful for determining where opportunities exist for additional energy savings. For example, the data collected from the 68 surveyed low-income homes indicates that 69.1 percent of these homes use oil or kerosene as a primary fuel for space heating. The 51 oil and kerosene-fired boilers and furnaces in these low-income homes have an average age of approximately 16.7 years and an average energy efficiency level below 80% AFUE. The current federal standard for residential hot water boilers is a minimum efficiency of 84% AFUE for oil-fired equipment and 83% AFUE for residential non-weatherized oil-fired furnaces. A program planner could use this information to determine the remaining potential for energy and dollar savings that could be obtained by upgrading older, inefficient oil-fired residential furnaces and boilers in low -income homes in Maine. This type of information can also be useful for determining the cost effectiveness of such equipment upgrades. GDS also notes that 31 percent of surveyed low-income households do not have their space heating equipment serviced annually. It is important to have space heating equipment serviced annually to ensure that the equipment will continue to operate efficiently and to ensure that the equipment will not fail during the long winter heating season in Maine. Furthermore, the data presented on the quality of HVAC duct sealing in Section 9 of this report indicates that 60.0% of the ductwork in low-income homes is partially or poorly sealed. GDS surveyors also found that (1) 67% of HVAC ductwork outside of conditioned space was not insulated and (2) 43% of low-income homes have manual thermostats. A program planner could use this information to provide support for a program targeted at (1) proper sealing and insulation of HVAC ductwork in low-income homes in Maine and (2) replacement of manual thermostats with programmable thermostats.

Table 4-1 provides a comparison of on-site survey data on primary heating fuels for single-family households in Maine in 2015 versus the 68 LIHEAP households surveyed by GDS in 2018. ***As shown in Table 4-1 below, fifty-three percent (52.9%) of Maine's LIHEAP households use oil as their primary space heating fuel***. The percent of LIHEAP households using kerosene, natural gas, wood, propane and electricity as their main home heating fuel are 16.2%, 11.8%, 5.9%, 5.9% and 5.9% respectively.

TABLE 4-1 PRIMARY FUEL USED FOR SPACE HEATING

Primary Heating Fuel	2015 Statewide Study – All Single-Family Households in Maine	2018 LIHEAP Study
Oil	72%	52.9%
Oil & Other	12%	0%
Natural Gas	4%	11.8%
Wood	4%	5.9%
LP	3%	5.9%
Kerosene	3%	16.2%
Electricity	0%	5.9%
LP & Other	2%	0%
Don't Know	0%	1.5%
Total	**100%**	**100.0%**
Number in Sample	**41**	**68**

Table 4-2 below provides a comparison of on-site and telephone survey data collected in 2015 by Efficiency Maine on primary heating fuels for single-family households in Maine versus the 68 LIHEAP households surveyed by GDS in 2018. Twelve percent (11.9%) of low-income homes in Maine use natural gas as a primary space heating fuel versus 4% for all single-family homes in Maine. On the other hand, 6.0% of low-income homes in Maine use wood as a primary heating fuel versus 17% in the 2015 Maine telephone survey of 164 single-family homes. It is clear that homes in Maine still rely predominately on fuel oil or kerosene as their primary space heating fuel.

TABLE 4-2 PRIMARY SPACE HEATING FUEL DETAILS

Primary Heating Fuel		Total Households	Fuel Oil & Kerosene	Fuel Oil & Other	Natural Gas	Wood	Liquid Propane	Liquid Propane & Other	Coal	Electricity	Other	Total
2015 Statewide Study	***On-site survey***	41	75%	12%	4%	4%	3%	2%	0%	0%	0%	100%
	Telephone survey	164	68%		4%	17%	6%		0%	1%	3%	99%
2018 LIHEAP Study	***On-site survey***	67*	70.1%	0%	11.9%	6.0%	6.0%	0%	0%	6.0%	0%	100.0%
2018 LIHEAP Database (All 38,322 LIHEAP Participants)		38,322	69%	0%	10%	4%	8%	0%	0.1%	9%	0%	100%

** One of the 68 respondents is not represented in the table above because the primary heating fuel for one household could not be determined. Percentages represented above therefore represent portions of the total 67 respondents that reported primary heating fuel information.*

Table 4-3 provides a comparison of on-site survey data on the type of heating equipment associated with the primary heating fuels for single-family households in Maine versus the 68 LIHEAP households surveyed by GDS in 2018. One clear difference is that 55.9% of LIHEAP households have furnaces as the main heating system while only 20% of all Maine single-family households have furnaces as a main heating system.

TABLE 4-3 PRIMARY SPACE HEATING EQUIPMENT

Heating Equipment Type for Primary Heating Fuel	2015 Statewide Study - % of Total	2018 LIHEAP Study - Frequency	2018 LIHEAP Study - % of Total
Boiler	62%	15	22.1%
Furnace	20%	38	55.9%
Wall-Mounted Space Heater	4%	3	4.4%
Boiler & Stove	8%	0	0%
Woodstove	6%	4	5.9%
Electric Baseboard	0%	2	2.9%
Heat Pump (AHP/DHP)	0%	2	2.9%
Other	0%	3	4.4%
Don't Know	0%	1	1.5%
Total	**100%**	**68**	**100.0%**

Table 4-4 provides detailed information on the heating capacity of primary heating systems installed in surveyed households. The majority of primary space heating systems had a system heating capacity from 80,000 – 89,999 Btuh. The average heating capacity was 71,014 Btuh.

TABLE 4-4 PRIMARY SPACE HEATING SYSTEM CAPACITY

Heating Capacity (Btuh)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0 - 9,999	3	5.3%	3	5.3%
10,000 – 19,999	1	1.8%	4	7.0%
20,000 – 29,999	0	0.0%	4	7.0%
30,000 – 39,999	4	7.0%	8	14.0%
40,000 – 49,999	6	10.5%	14	24.6%
50,000 – 59,999	3	5.3%	17	29.8%
60,000 – 69,999	6	10.5%	23	40.4%
70,000 – 79,999	2	3.5%	25	43.9%
80,000 – 89,999	14	24.6%	39	68.4%
90,000 – 99,999	4	7.0%	43	75.4%
100,000 – 109,999	3	5.3%	46	80.7%
110,00 – 119,999	4	7.0%	50	87.7%
120,000 – 129,000	2	3.5%	52	91.2%
130,000 – 139,000	2	3.5%	54	94.7%
140,000 – 149,000	0	0.0%	54	94.7%
150,000 – 159,000	2	3.5%	56	98.2%
180,000 – 189,000	1	1.8%	57	100.0%

Table 4-5 provides more detailed information on the types of space heating equipment installed in Maine households. Based on the data presented in this Table, the average equipment energy efficiency level is lower in the LIHEAP households surveyed in 2018 than in the baseline survey of 41 single-family households completed in 2015.

TABLE 4-5 EFFICIENCY OF PRIMARY SPACE HEATING EQUIPMENT

	2015 Statewide Study				2018 LIHEAP Study			
Equipment	Fuel	Number of Systems	Efficiency Unit	Average Efficiency	Fuel	Number of Systems	Efficiency Unit	Average Efficiency
Boilers	Oil	27	AFUE	83%	Oil	13	AFUE	76% [23]
	Gas	2		83%	Gas	1		84%
	Propane	1		86%	Propane	0		-
	Pellet	1		90%	Pellet	0		-
	Kerosene	0		-	Kerosene	1		Not Available
	All boilers	*31*		*83%*	*All boilers*	*15*		*76%*
Furnaces	Oil	7	AFUE	81%	Oil	22	AFUE	78% [24]
	Kerosene	1		80%	Kerosene	8		76%
	Gas	0		-	Gas	4		88% [25]
	Propane	0		-	Propane	3		80% [26]
	Electric	0		-	Electric	1		75%
	All furnaces	*8*		*81%*	*All furnaces*	*38*		*79%*
Stoves	Wood	2	% Efficient	72%	Wood	4	% Efficient	69% [27]
	Pellet	1		74%	Pellet	0		-
	Propane	1		79%	Propane	0		-
	All stoves	*4*		*74%*	*All stoves*	*4*		*69%*
Space Heaters (Wall-Mounted)	Electric	8	COP	1.0	Electric	0	COP	-
	Propane	1	% Efficient	70%	Propane	0	% Efficient	-
					Gas	2		80%
	All space heaters	*9*	*Overall*	-	Kerosene	1		87%
					All space heaters	3		82%
Baseboard	Oil	N/A	AFUE	-	Oil	1	AFUE	Not Available

[23] Based on 7 available efficiency ratings out of 13.
[24] Based on 9 available efficiency ratings out of 22.
[25] Based on 2 available efficiency ratings out of 4.
[26] Based on 1 available efficiency ratings out of 3.
[27] Based on 3 available efficiency ratings out of 4.

	2015 Statewide Study				2018 LIHEAP Study			
Equipment	**Fuel**	**Number of Systems**	**Efficiency Unit**	**Average Efficiency**	**Fuel**	**Number of Systems**	**Efficiency Unit**	**Average Efficiency**
	Electric	N/A	% Efficient	-	Electric	1	COP	100%
	All baseboards	N/A	*Overall*	-	*All baseboards*	*2*		*100%*
Air Source Heat Pump	Coal/Wood	N/A	% Efficient		Wood	1	COP	Not Available
	All air source heat pumps	N/A			*All air source heat pumps*	*1*		*Not Available*
Ductless Heat Pump	Electric	N/A	AFUE		Electric	1	COP	Not Available
	All ductless heat pumps	N/A	% Efficient		*All ductless heat pumps*	*1*		*Not Available*
Other	Gas	N/A	AFUE	-	Gas	1	AFUE	81%
	Propane	N/A	% Efficient	-	Propane	1		Not Available
	Electric	N/A		-	Electric	1	COP	Not Available
	All other	N/A	*Overall*	-	*All other*	*3*		*81%*
Don't Know		-				*1*		*Not Available*
Total		***52***				***68***		

Table 4-6 below provides a breakdown of observed space heating equipment in the surveyed LIHEAP homes by fuel and equipment type. The following table however excludes information on the 54 portable space heaters and the 1 fireplace used for supplemental heating. The three percentages provided in the chart below for each equipment type and fuel type from top to bottom are as follows: percentage of total water heating units, percentage of total equipment type in the row, and percentage of total fuel type in the column.

TABLE 4-6 BREAKDOWN OF ALL SPACE HEATING EQUIPMENT (PRIMARY & SUPPLEMENTAL)

	Gas		Electric		Propane		Kerosene		Oil		Wood		Dual-Fuel		Don't Know		
	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total
Furnace	4	4.0%	2	2.0%	3	3.0%	11	11.1%	25	25.3%	0	0.0%	0	0.0%	0	0.0%	45
		8.9%		4.4%		6.7%		24.4%		55.6%		0.0%		0.0%		0.0%	
		50.0%		25.0%		60.0%		73.3%		61.0%		0.0%		0.0%		0.0%	
Boiler	1	1.0%	0	0.0%	0	0.0%	1	1.0%	14	14.1%	0	0.0%	0	0.0%	0	0.0%	16
		7.7%		0.0%		0.0%		7.7%		87.5%		0.0%		0.0%		0.0%	
		12.5%		0.0%		0.0%		6.7%		34.1%		0.0%		0.0%		0.0%	
Baseboard	0	0.0%	2	2.0%	0	0.0%	0	0.0%	1	1.0%	0	0.0%	0	0.0%	0	0.0%	3
		0.0%		66.7%		0.0%		0.0%		33.3%		0.0%		0.0%		0.0%	
		0.0%		25.0%		0.0%		0.0%		2.4%		0.0%		0.0%		0.0%	
Wall-Mounted Space Heater	2	2.0%	1	1.0%	1	1.0%	1	1.0%	1	1.0%	0	0.0%	0	0.0%	0	0.0%	6
		33.3%		16.7%		16.7%		16.7%		16.7%		0.0%		0.0%		0.0%	
		25.0%		12.5%		20.0%		6.7%		2.4%		0.0%		0.0%		0.0%	
Air Source Heat Pump	0	0.0%	1	1.0%	0	0.0%	0	0.0%	0	0.0%	1	1.0%	0	0.0%	1	1.0%	3
		0.0%		33.3%		0.0%		0.0%		0.0%		33.3%		0.0%		33.3%	
		0.0%		12.5%		0.0%		0.0%		0.0%		5.6%		0.0%		50.0%	
Geo. Heat Pump	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0
		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
Ductless Heat Pump	0	0.0%	2	2.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2
		0.0%		100.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
		0.0%		25.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
Wood Stove	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	15	15.2%	2	2.0%	0	0.0%	17
		0.0%		0.0%		0.0%		0.0%		0.0%		88.2%		11.8%		0.0%	
		0.0%		0.0%		0.0%		0.0%		0.0%		83.3%		100.0%		0.0%	
Other	1	1.0%	0	0.0%	1	1.0%	2	2.0%	0	0.0%	2	2.0%	0	0.0%	0	0.0%	6
		16.7%		0.0%		16.7%		33.3%		0.0%		33.3%		0.0%		0.0%	
		12.5%		0.0%		20.0%		13.3%		0.0%		11.1%		0.0%		0.0%	

	Gas		Electric		Propane		Kerosene		Oil		Wood		Dual-Fuel		Don't Know		
	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total Units	Percent	Total
Don't Know	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.0%	1
		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		100.0%	
		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		0.0%		50.0%	
Total	8		8		5		15		41		18		2		2		99

Table 4-7 below provides information on the number of all observed space heating units (68 primary systems observed in addition to the 86 supplemental systems observed) in surveyed homes, the percentage of heating equipment units manufactured before 1995 and the average ages of observed units. The average age of all boilers observed was 16.5 years, about the same as the 2015 baseline of 17 years. The average age of all observed furnaces in surveyed homes was 15.5 years, substantially below the 2015 baseline value of 24 years. The average age of all central heating units (including boilers and furnaces) was 29.7 years, significantly older than the baseline value of 19 years.

TABLE 4-7 AVERAGE AGE OF ALL OBSERVED SPACE HEATING SYSTEM EQUIPMENT (PRIMARY & SECONDARY)

	Boilers		Furnaces		All Central Heating	
Year of Manufacture	2015 Statewide	2018 LIHEAP	2015 Statewide	2018 LIHEAP	2015 Statewide	2018 LIHEAP
Number of Units	32	16	10	45	42	99
1995 or Earlier	28%	37.5%	90%	15.6%	43%	17%
Average Age (Years)	17	16.5	24	15.5	19	29.7
Minimum Age (Years)	2	1	17	1	2	1
Maximum Age (Years)	> 45	30	37	48	> 45	65

Table 4-8 below displays information on average output capacity for all observed heating equipment in all surveyed homes including primary, secondary and tertiary heating units. There was a total of 97 major non-portable space heating systems observed in the 68 homes where on-site surveys were conducted. The information below includes supplemental heating units in addition to primary heating units. Information on wall-mounted space heating units is also included. Average output capacity across all observed units was determined to be 73 kBtuh.

TABLE 4-8 AVERAGE OUTPUT CAPACITY FOR ALL INSTALLED HEATING EQUIPMENT

	2015 Statewide Study		2018 LIHEAP Study	
Heating System Type	N	Average Capacity (kBTUh)	N	Average Capacity (kBtuh)
Boilers	32	124	16	96
Fuel Oil	27	129	14	104
Natural Gas	2	109	1	97
Propane	1	106	0	-
Wood Pellet	1	54	0	-
Kerosene	0	-	1	Not available
Furnaces	10	93	45	80
Fuel Oil	9	97	25	93
Kerosene	1	68	11	56
Natural Gas	0	-	4	93
Electric	0	-	2	75
Propane	0	-	3	80
All Fossil Fuel-Fired Central Heating Units (Including Boilers & Furnaces)	**42**	**118**	**99**	**73**

As the 2015 statewide study provides efficiency breakdown information for boilers and furnaces only, only boilers and furnaces observed in the surveyed homes were included in the table above for more fluid comparison with the baseline. The following types of space heating equipment are broken down by fuel type in the table above, although they are included in the 99 total space-heating units: baseboard, wall-mounted space heater, air-source heat pump, geothermal heat pump, ductless heat pump, wood stove, and all other space heating equipment.

Table 4-9 below provides information on only supplemental space heating units observed in surveyed homes by system type and fuel type. This table includes information on heating systems in use for supplemental heating in the 68 surveyed LIHEAP homes, including portable space heaters and fireplaces. It is clear that low-income homes in Maine use portable space heaters for supplemental heating equipment much more than the general population of all homes.

TABLE 4-9 BREAKDOWN OF SUPPLEMENTAL EQUIPMENT (SECONDARY & TERTIARY SYSTEMS ONLY) BY FUEL TYPE

	2015 Statewide Study			2018 LIHEAP Study		
Equipment type	% of Homes Using Equip. for Supplemental Heating	Fuel	Total Units	% of Homes Using Equip. for Supplemental Heating	Fuel	Total Units
Stoves	44%	*Wood*	*11*	18%	*Wood*	*11*
		Dual-Fuel	*0*		*Dual-Fuel*	*2*
		Pellet	*6*		*Pellet*	*0*
		Propane	*2*		*Propane*	*0*
		All stoves	*19*		*All stoves*	*13*
Furnaces		-		9%	*Electric*	*1*
					Oil	*3*
					Kerosene	*3*
					All furnaces	*7*
Wall-Mounted Space Heaters		-		4%	*Electric*	*1*
					Oil	*1*
					Propane	*1*
					All wall-mounted space heaters	*3*
Boilers		-		2%	*Oil*	*1*
Electric Baseboard	10%	*Electric*	*4*	2%	*Electric*	*1*
Ductless Heat Pump	6%	*Electric*	*3*	2%	*Electric*	*1*
		-		3%	*Electric*	*1*

Air-Source Heat Pump					*Unknown*	*1*
					All air-source heat pumps	*2*
Portable Space Heaters	*32%*	*Electric*	*26*	*50%*	*Electric*	*45*
		Propane	*2*		*Non-Electric*	*7*
		All portable space heaters	*28*		*All portable space heaters*	*52*
Fireplaces	*Not Available*	*Propane*	*4*	*2%*	*Propane*	*-*
		Wood	*1*		*Wood*	*-*
		All fireplaces	*5*		*All fireplaces*	*1*
Other		*-*		*4%*	*Kerosene*	*1*
					Wood	*2*
					All other	*3*
All Supplemental Heating Equipment	*64%*	*--*	*59*	*62%*	*--*	*86*

* *(Assumes that all portable space heaters observed in homes are in use and are used as supplemental systems only and assumes that all fireplaces in use are used as supplemental systems only.)*

Table 4-10 below displays the frequency of portable space heaters observed in surveyed homes. Fifty-one percent (50.7%) of surveyed homes had at least one portable space heater, significantly above the 2015 baseline saturation of 32%. Ninety-four percent (94.1%) of surveyed homes with at least one portable space heater had 1 or 2 portable space heaters. No homes surveyed had more than 4 portable space heaters.

TABLE 4-10 NUMBER OF PORTABLE SPACE HEATERS IN THE HOME

Number of Portable Space Heaters	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	33	49.3%	33	49.3%
1	17	25.4%	50	74.6%
2	15	22.4%	65	97.0%
3	1	1.5%	66	98.5%
4	1	1.5%	67	100.0%
Missing Responses = 1				

The data in Table 4-11 shows that 23 out of 62 homes with applicable space heating equipment (37.1%) reported that they do not have their space heating equipment serviced on an annual basis. Twenty-seven percent (26.9%) of LIHEAP households surveyed have not had their heating equipment serviced within the past two years. This information was reported by survey respondents to the GDS surveyors.

TABLE 4-11 NUMBER OF YEARS SINCE SPACE HEATING (FURNACES , BOILERS, ETC.) EQUIPMENT WAS SERVICED

	Number of LIHEAP Households	2018 LIHEAP Study - % of LIHEAP Households
Less than 1 Year	35	52.2%
1 – 2 Years	14	20.9%
More than 2 Years	7	10.5%
Never (Repair Only)	2	3.0%
Equipment Less than 1 Year Old	3	4.5%
Don't Know	4	6.0%
Not Applicable	2	3.0%
Total Responses	**67**	**100.0%**

5 Water Heating Fuels & Equipment

GDS observed 64 total water heating units in the 68 surveyed LIHEAP homes. Of the 64 units, 2 were supplemental water heating units in separate homes and the remaining units were primary systems. It is important to note that a trained GDS surveyor collected all housing characteristics and energy using equipment information through an on-site visit to each of the 68 surveyed homes.

Figure 5-1 displays a breakdown of fuel type for the 62 primary water heating units observed in the 68 surveyed LIHEAP homes.[28] GDS surveyors were not able to determine the primary water heating fuel or type of water heater in six of the surveyed homes because the water heating equipment was located in a space that was not accessible during the on-site survey.[29] Electricity is the water heating fuel in 61.3% of the primary water heating equipment in the surveyed homes. Oil-fired systems follow at 21.0%. Natural gas and propane-fired systems each represent 8.1% of primary water heating units.

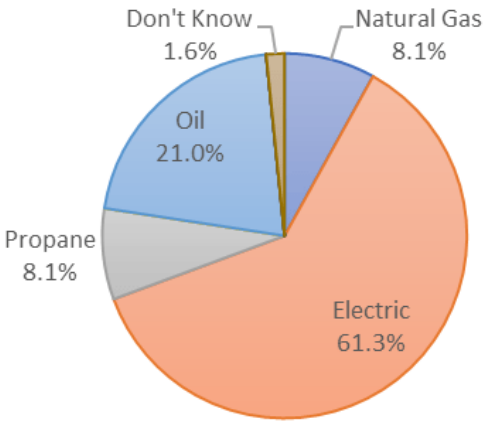
Figure 5-2 provides a breakdown of fuel type for the 62 primary water heating units and the 2 supplemental water heating units observed in surveyed homes. Electricity is the water heating fuel in 60.9% of the primary and supplemental water heating equipment installed in surveyed homes followed by oil-fired water heating units at 20.3%. Propane and natural gas -fired systems represent 9.4% and 7.8% of total water heating units respectively.

[28] GDS notes that the LIHEAP Excel database does provide the main fuel for space heating in LIHEAP housing units but this database does not provide information on the main fuel used for water heating.

[29] For six of the LIHEAP homes, the water heating equipment for the home was located in a space that was not accessible to the GDS surveyor during the 2 to 3-hour window of time that the surveyor collected data in each home. Two examples of water heating equipment that were not accessible include the following:

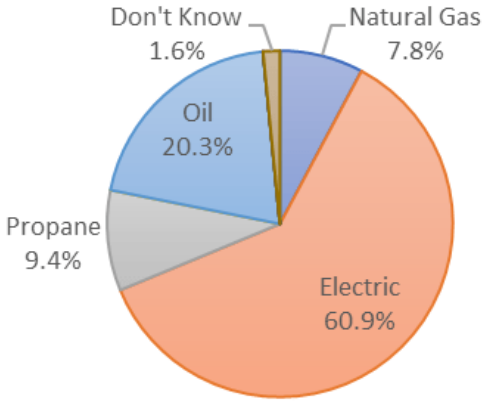
1. In one home surveyed by GDS, the home was a mobile home and the water heater was installed in a space behind the closet in the master bedroom. To access the water heater to collect data, the GDS surveyor would have needed to remove all clothes from the master bedroom closet, unscrew numerous metal screws, take down a wall and remove insulation. The occupant of the mobile home did not want the GDS surveyor to take down the wall, as it had never been moved. This mobile home does have a water heater, but the GDS surveyor could not access it during this on-site survey.
2. In a second survey completed by a GDS surveyor, the home was an apartment unit. The unit's water heater was installed behind a wall in a location that only the apartment house owner could access. The apartment house owner was not available at the time of the survey to provide the GDS surveyor with access to the water heater.

FIGURE 5-1 PRIMARY WATER HEATING FUEL BREAKDOWN



(Based on 62 water heating units)

FIGURE 5-2 WATER HEATING FUEL BREAKDOWN (PRIMARY & SUPPLEMENTAL)

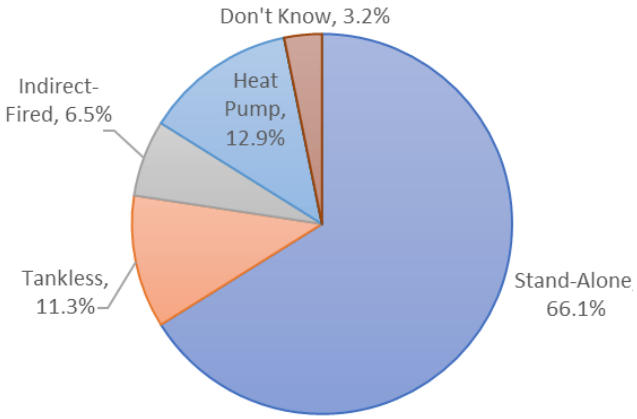


(Based on 64 water heating units – 62 primary units, 2 supplemental units)

Figure 5-3 provides a breakdown of equipment type for the 62 primary water heating units observed in surveyed homes. For purposes of this report, GDS has reported heat pump water heating systems separately from stand-alone water heaters. For purposes of this report, a stand-alone water heating tank is a water heater that heats water with electricity or a fossil fuel and stores it in a large, multi-gallon, insulated tank excluding high efficiency heat pump water heaters. Stand-alone units account for the majority of water heating units at 66.1% followed by heat pump systems (12.9%), tankless (11.3%), and indirect-fired (6.5%).

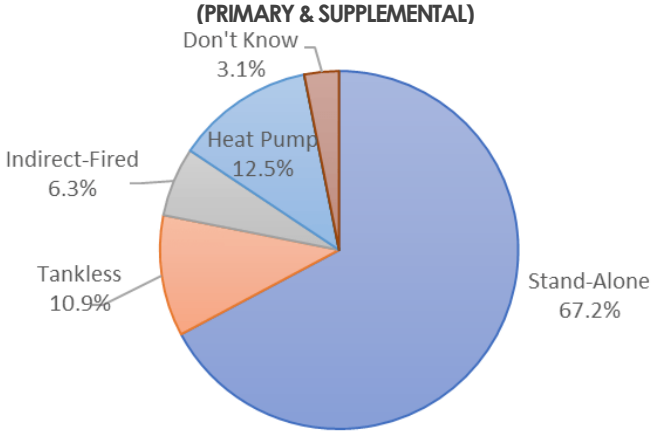
Figure 5-4 provides a breakdown of equipment type for the 62 primary and two supplemental water heating units observed in surveyed homes. Stand-alone systems account for 67.2% of all units followed by heat pump systems (12.5%), tankless (10.9%), and indirect-fired (6.3%).

FIGURE 5-3 PRIMARY WATER HEATING EQUIPMENT BREAKDOWN



(Based on 62 water heating units)

FIGURE 5-4 WATER HEATING EQUIPMENT BREAKDOWN (PRIMARY & SUPPLEMENTAL)



(Based on 64 water heating units – 62 primary units, 2 supplemental units)

Table 5-1 presents data on the portion of primary fuels used for water heating equipment observed in surveyed homes. GDS observed sixty-one percent (61.3%) of surveyed homes having electric water heating as their primary system, followed by 21.0% with oil-fired water heating, 8.1% with natural gas water heating and 8.1% with propane-fired water heating. Two percent (1.6%) of respondents reported not knowing their primary fuel for water

heating. Six of the 68 surveyed homes (8.8%) had no observable water heating units. No homes surveyed had kerosene, coal, solar, wood, or other fuels as their primary fuel for water heating.

TABLE 5-1 PRIMARY FUEL FOR WATER HEATING

Primary Fuel for Water Heating	2018 LIHEAP Study	Number of Systems
Natural Gas	8.1%	5
Electric	61.3%	38
Propane	8.1%	5
Kerosene	0.0%	0
Oil	21.0%	13
Coal	0.0%	0
Solar	0.0%	0
Wood	0.0%	0
Other	0.0%	0
Don't Know	1.6%	1
Total Responses	**100.0%**	**62**

Table 5-2 provides information on tank capacity for all observed primary water heating systems. The majority of primary water heating units installed in surveyed homes had tank capacities of 40 gallons. The average tank capacity of observed systems was 39 gallons.

TABLE 5-2 PRIMARY WATER HEATING TANK CAPACITY

Tank Capacity (Gallons)	Frequency	Percent of Total
0 - 9	2	3.9%
10 – 14	0	0.0%
15 – 19	1	2.0%
20 – 24	1	2.0%
25 – 29	0	0.0%
30 – 34	6	11.8%
35 – 39	2	3.9%
40 – 44	27	52.9%
45 – 49	1	2.0%
50 – 55	11	21.6%
Total Responses	**51**	**100.0%**

Table 5-3 presents data on the types of water heating equipment observed in surveyed homes to the 2015 baseline and the 2018 Low-Income Baseline Study. GDS collected data on all water heating equipment installed in the 68 surveyed homes. Two homes of the 68 homes surveyed in 2018 had an additional supplemental water heating unit. In total, 64 water heating units were observed. Based on the data below, stand-alone systems (not integrated into a controlled heated water delivery system) account for the majority of water heating systems in surveyed low-income homes at 67.2%, more than twice than the 2015 baseline of 28%. Heat pump water heating systems followed at 12.5%, significantly higher than the 2015 baseline of 5%. The observed incidence of tankless systems

(10.9%) in surveyed low-income homes was over twice that of the 2015 baseline (5%). Indirect-fired systems (6.3%) observed accounted for a significantly lower proportion of systems compared to the 2015 baseline of 31%. No homes surveyed had solar water heating systems compared to 3% of all 2015 single-family residential homes.

Note that the 2015 statewide study for single-family homes had a larger percentage of homes with indirect water heating systems due to the fact that single-family homes in Maine tend to rely more on boiler central heating systems than this 2018 low-income baseline study which has a higher percentage of mobile homes among the survey respondents. The housing types in this 2018 low-income baseline study is more diverse and covers all types of housing, not just single-family homes.

TABLE 5-3 WATER HEATING EQUIPMENT TYPES (PRIMARY & SUPPLEMENTAL)

Water Heating System Types	2015 Statewide Study	Number of systems	2018 LIHEAP Study	Number of Systems
Stand-Alone	28%	12	67.2%	43
Heat Pump	5%	2	12.5%	8
Indirect-Fired	31%	14	6.3%	4
Tankless	33%	15	10.9.%	7
Solar	3%	1	0%	0
Don't Know	-	-	3.1%	2
Total Responses	**100%**	**44**	**100.0%**	**64**

Table 5-4 compares 2018 survey data on the average ages of water heating systems and date of equipment manufacture to the 2015 baseline study data. The following information excludes the 2 water heating units for which the system type could not be identified of the 64 total water heating units observed.

TABLE 5-4 AVERAGE AGES OF WATER HEATING UNITS (PRIMARY & SUPPLEMENTAL)

	2015 Statewide Study			2018 LIHEAP Study		
Water Heating System Types	N	Average Age (Years)	Manufactured Prior to 2005	N	Average Age (Years)	Manufactured Prior to 2005
Indirect-Fired	14	12	73%	4	18.75	75%
Tankless	15	19	69%	7	8.75	14.6%
Stand-Alone	12	12	42%	43	7.83	25.6%
Heat Pump	2	1	0%	8	1.25	0%
Solar	1	12	0%	0	-	-
Total	**44**			**62**		

Table 5-5 below provides information on the presence of pipe insulation wrap on hot water pipes associated with primary water heating units in surveyed homes. The majority of homes (59.3%) did not have existing pipe wrap for hot water pipes associated with their primary water heating units. Only 25.4% of primary water heating units also had pipe wrap.

TABLE 5-5 PRESENCE OF PIPE WRAP FOR PRIMARY WATER HEATING UNITS

Pipe Wrap Present	Frequency	Percent of Total
Yes	15	25.4%
No	35	59.3%
Don't Know	9	15.3%
Total Responses	**59**	**100.0%**

Table 5-6 provides information on the presence of water heater blankets on primary water heating units. The majority of surveyed homes (76%) had no water heater blanket for their primary water heater. Only 7% had a water heater blanket.

TABLE 5-6 PRESENCE OF WATER HEATER BLANKETS FOR PRIMARY WATER HEATING UNITS

Pipe Wrap Present	Frequency	Percent of Total
Yes	4	6.8%
No	45	76.3%
Don't Know	10	16.9%
Total Responses	**59**	**100.0%**

Table 5-7 provides information on the temperature setting of the primary water heating unit in surveyed homes. The majority of respondents had a hot water temperature setting of 120 °F. The average temperature setting for primary water heating units was 118.3 °F.

TABLE 5-7 TEMPERATURE SETTINGS OF PRIMARY WATER HEATING UNITS

Temperature Setting (°F)	Frequency	Percent of Total
0 - 99	1	3.9%
100 – 109	3	0.0%
110 – 119	9	2.0%
120 – 129	37	2.0%
130 – 139	1	0.0%
140 – 149	2	11.8%
Total Responses	**53**	**100.0%**

6 Cooling Systems

Table 6-1 provides the number and percentage of cooling systems by equipment type, the average age of cooling systems by equipment type, and the average energy efficiency of systems by equipment type observed in surveyed homes compared with data from the 2015 baseline study. The average efficiency rating of room air conditioners in the 2018 study is 10.3 EER.

TABLE 6-1 COOLING SYSTEM EFFICIENCY

	2015 Statewide Study			2018 LIHEAP Study		
Cooling System Type	Number of systems	Average Efficiency	Average Age (Years)	Number of Systems	Average Efficiency	Average Age (Years)
Room Air Conditioners	17	10.1 EER	10	57	10.3 EER	8
Heat Pumps (incl. DHP)	3	21.5 SEER	2	0	-	-
Central Air Conditioners	1	10.0 SEER	-	3	Not Available [30]	4
Total Responses	**21**			**60**		

Table 6-2 provides the frequency of room air conditioners observed in the 68 surveyed LIHEAP homes. Thirty-six of the 68 homes (52.9%) had at least one room air conditioning unit. Thirty-one percent (30.9%) of surveyed homes had only one unit and 14.7% had 2 units. Six percent (5.9%) of surveyed homes had 3 units. No homes surveyed had more than 4 room air conditioners.

TABLE 6-2 NUMBER OF ROOM AIR CONDITIONERS

Number of Room Air Conditioners	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	32	47.1%	32	47.1%
1	21	30.9%	53	77.9%
2	10	14.7%	63	92.7%
3	4	5.9%	67	98.5%
4	1	1.5%	68	100.0%

Table 6-3 below provides the EER efficiency ratings of room air conditioners observed in the 68 surveyed LIHEAP homes. Efficiency ratings of room air conditions ranged from 8 EER to 12.1 EER. Nine percent (8.8%) of units had an EER rating of 9.7. Surveyors and members of the GDS team were unable to determine efficiency ratings of installed room air conditioners in fifty-four percent (54.4%) of homes.

[30] GDS surveyors were unable to determine the efficiency rating for the three central air conditioners observed.

TABLE 6-3 ENERGY EFFICIENCY RATINGS OF ROOM AIR CONDITIONERS

EER Rating	Frequency	Percent	Cumulative Frequency	Cumulative Percent
8	1	1.8%	1	1.8%
8.66	1	1.8%	2	3.5%
9.17	1	1.8%	3	5.3%
9.2	1	1.8%	4	7.0%
9.7	5	8.8%	9	15.8%
9.8	3	5.3%	12	21.1%
9.9	1	1.8%	13	22.8%
10	1	1.8%	14	24.6%
10.7	1	1.8%	15	26.3%
11	3	5.3%	18	31.6%
11.1	2	3.5%	20	35.1%
11.2	2	3.5%	22	38.6%
11.3	1	1.8%	23	40.4%
12	2	3.5%	25	43.9%
12.1	1	1.8%	26	45.6%
Don't Know	23	40.4%	49	86.0%
No EER Provided by Surveyor	8	14.0%	57	100.0%

Table 6-4 below displays a breakdown of the primary air conditioning system by type of system. Only 3 homes of the 68 surveyed homes (4.4%) had a central air conditioning system. Two of the 3 units were heat pump system, and the remaining system was a ground source heat pump (GSHP) system.

TABLE 6-4 BREAKDOWN OF PRIMARY AIR CONDITIONING UNITS BY EQUIPMENT TYPE

System Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Heat Pump	2	66.7%	2	66.7%
GSHP	1	33.3%	3	100.0%

7 Lighting

GDS surveyors collected detailed information on every light bulb socket and light bulb in the interior and exterior of the 68 surveyed homes. For each socket GDS collected the room type (living room, dining room, kitchen, bedroom, etc.) where the socket is located, type of socket (medium Edison base, pin base, candelabra, night light, other), bulb type, bulb wattage, and presence of a lighting control. The aggregated lighting data determined that 37.9% of interior and 35.0% of exterior light bulbs are incandescent bulbs.

7.1.1 Interior Lighting

GDS on-site surveyors found a total of 1,980 light bulb sockets in the interior of the 68 low-income homes in Maine where on-site surveys were completed in the February to June 2018 time period. On average, Maine's low-income homes have 29.1 interior light bulb sockets per home.[31] Five of these 1,980 sockets did not have a light bulb installed. The type of light bulb installed could not be identified for 15 sockets. The average number of installed interior light bulbs is 29.0 light bulbs per low-income home.

In these 68 low-income homes, incandescent bulbs are still the most prevalent type of interior light bulb, with a count of 749 regular incandescent bulbs and 10 three-way incandescent bulbs. Regular incandescent and three-way incandescent bulbs are installed in 38.3% of all interior sockets found on-site. LED bulbs are installed in 23.9% of sockets. CFLs are installed in 23.3% of sockets. Together, LEDs (23.9%) and CFLs (23.3%) account for 47.2% of bulbs. The 2018 saturation of LED bulbs of 23.9% in the interior of low-income homes is significantly higher than the 2015 saturation of LED bulbs of 9% recorded in all single-family homes.

Seventy-seven percent (76.5%) of LIHEAP homes have at least one LED bulb in the interior of the house, and 29.4% have at least one LED bulb for exterior lighting. Forty-six percent (45.6%) of LIHEAP homes have at least one LED bulb in storage. [32]

[31] GDS surveyors collected Data on each light bulb socket in the interior and exterior of LIHEAP homes participating in this baseline study. If a lighting fixture had three light bulb sockets, GDS collected data on each of these sockets.

[32] Upon comparison with the general homeowner population, the observed incidence of LED bulbs in surveyed homes (24%) is significantly higher than the incidence expected by Efficiency Maine Trust staff. This raises the possibility that the survey respondent group may differ in key characteristics from the general population of LIHEAP participants. It is possible that the low-income households that volunteered to participate in this baseline study are more likely to install LED bulbs than households that did not volunteer to participate in this study. This phenomenon is known as "self-selection bias".

Table 7-1 below provides a breakdown of the 1,975 interior light bulbs installed in surveyed homes by light bulb type.

TABLE 7-1 TYPES OF LIGHT BULBS INSTALLED IN INTERIORS OF ALL MAINE SINGLE-FAMILY VERSUS MAINE LIHEAP HOMES

Types of Interior Light Bulbs Installed in Maine Homes	Number of Bulbs	2015 Statewide Study – All SF Households in Maine - % of Total	Number of Bulbs	2018 LIHEAP Study % of Total Sockets
Incandescent	1,174	46%	749	37.8%
Modified Halogen	0	0%	12	0.5%
CFL	715	28%	462	23.3%
Tube Fluorescent	255	10%	206	10.4%
LED	230	9%	473	23.9%
3-Way Incandescent	0	0%	10	0.5%
3-Way CFL	0	0%	1	0.1%
Halogen	179	7%	45	2.3%
Pulse Start Metal Halide	0	0%	0	0%
Other	0	0%	2	0.1%
Don't Know Type of Bulb	0	0%	15	0.8%
Total	**2,553**	**100%**	**1,975**	**100.0%**
Number Of Homes in Sample	**41**		**68**	

Table 7-2 provides the percentage of homes with at least one LED bulb installed in interiors and exteriors, and in storage at all surveyed LIHEAP homes. Seventy-seven percent (76.5%) of surveyed homes had at least one interior LED bulb installed and 29.4% had at least one exterior LED bulb installed. This is compared with 46% of all single-family homes with at least one LED bulb installed in either the interior or exterior in the 2015 statewide study. Forty-six percent of surveyed homes (45.6%) had at least one LED bulb in storage.

TABLE 7-2 PERCENT OF LIHEAP HOMES WITH AT LEAST ONE LED BULB

	Number of LIHEAP Homes	Percent of LIHEAP Homes
Interior Lighting	52 of 68 homes	76.5%
Exterior Lighting	20 of 68 homes	29.4%
In Storage	31 of 68 homes	45.6%

7.1.2 Exterior Lighting

GDS on-site surveyors found a total of 197 light bulb sockets on the exterior of the 68 low-income homes in Maine where on-site surveys were completed in the February to June 2018 time period. On average, Maine's low-income homes have 2.9 exterior light bulb sockets per home. All of these exterior sockets have a light bulb installed. The type of light bulb installed could not be identified for one bulb. The average number of installed exterior light bulbs is 2.9 light bulbs per low-income home.

As shown in Table 7-3, incandescent bulbs are still the most prevalent type of exterior bulb installed at these 68 low-income homes, with a count of 69 regular incandescent bulbs and zero three-way incandescent bulbs. Incandescent bulbs are installed in 35.0% of all exterior sockets found on-site. LED bulbs are installed in 22.3% of exterior sockets. CFLs are installed in 24.4% of exterior sockets. Together, LEDs (22.3%) and CFLs (24.4%) account for 46.7% of exterior bulbs.

TABLE 7-3 TYPES OF EXTERIOR LIGHT BULBS FOR ALL MAINE SINGLE-FAMILY VERSUS MAINE LOW-INCOME HOMES

Types of Exterior Light Bulbs Installed in Maine Homes	Number of Exterior Bulbs	Percent of Total Exterior Sockets
Incandescent	69	35.0%
Modified Halogen	2	1.0%
CFL	48	24.4%
Tube Fluorescent	4	2.0%
LED	44	22.3%
3-Way Incandescent	0	0%
3-Way CFL	0	0%
Halogen	29	14.7%
Pulse Start Metal Halide	0	0%
Other	0	0%
Don't Know Type of Bulb	1	0.5%
Total	**197**	**100.0%**
Number of Homes in Sample	**68**	**68**

7.1.3 Bulbs in Storage

As shown in Table 7-4, 33.7% of bulbs in storage in Maine low-income homes are LED bulbs, 30.2% are CFLs and 31.9% are incandescent. The remaining 4.2% of bulbs are tube fluorescent, halogen, or modified halogen bulbs.

TABLE 7-4 TYPES OF LIGHT BULBS IN STORAGE FOR ALL MAINE SINGLE-FAMILY VERSUS MAINE LOW-INCOME HOMES

Types of Light Bulbs in Storage in Maine Low-Income Homes	Number of Bulbs in Storage by Bulb Type	Percent of Total Bulbs in Storage
Incandescent	190	31.9%
Modified Halogen	5	0.8%
CFL	180	30.2%
Tube Fluorescent	4	0.7%
LED	201	33.7%
3-Way Incandescent	1	0.2%
3-Way CFL	0	0%
Halogen	15	2.5%
Pulse Start Metal Halide	0	0%
Other	0	0%
Don't Know	0	0%
Total	**596**	**100.0%**
Number of Homes in Sample	**68**	**68**

7.1.4 Lighting Controls

Table 7-5 provides information on the presence of existing lighting controls on all installed light bulbs (interior and exterior) in surveyed homes. The vast majority of interior light bulbs (98.0%) did not have lighting controls present, while more exterior bulbs (7.1%) had lighting controls present.

TABLE 7-5 OBSERVED LIGHTING CONTROLS

Type of Light Bulb	Total Bulbs	Number of Controls	Percent of Total Bulbs	Control Type	Number of Controls	Percent of Total Controls
Interior	1,975	39	2.0%	Occupancy Sensor	4	0%
				Dimmer Switch	35	1.8%
				Photocell	0	0%
Exterior	197	14	7.1%	Occupancy Sensor	0	0%
				Dimmer Switch	0	0%
				Photocell	14	7.1%

7.1.5 Load Profile Analysis

The purpose of this lighting study is to provide updated lighting load profile information to the OPA to assist in the calculations of the remaining potential for electric peak demand and energy savings for lighting energy efficiency (EE) programs in Maine. Specifically, this report presents lighting load shapes, coincidence factors (CFs) and hours of use (HOU) data.

Onsite Survey and Logger Installation

Once onsite, field technicians completed a detailed survey of lighting sockets. They collected counts of bulbs by room type, bulb type (CFL, incandescent, tube fluorescent, etc.) control type (e.g., dimmer switch), and wattage. A random number generator was used prior to the on-site survey in each home to assign a randomly selected number corresponding to one specific light bulb for each room/location type. These numbers ranged from 10 to 25.[33] Loggers were carefully installed to ensure the meters measured the status of the light of interest but did not receive interference from ambient light.

Within the 68 homes, up to 7 light loggers were installed (save for one household in which no light loggers were installed due to privacy concerns expressed by the homeowner). GDS elected to analyze lighting characteristics across the following room/location types: living rooms, dining rooms, bathrooms, kitchens, bedrooms, hallways, and exteriors. This was done with the expectation that certain room types (e.g. garages, offices, utility rooms) would not be encountered often enough during site surveys to achieve sample size targets. A total of 449 loggers were installed in the 67 participating homes, an average of 6.7 loggers per home.

GDS opted to use Dent Instruments' LIGHTINGlogger 4G devices for monitoring lighting use in selected room/location types. The selected loggers are non-intrusive and are relatively simple to install using either attached magnets or electrical ties. Despite the ease of installation, GDS had concerns on the accuracy of the loggers'

[33] GDS used a random number generator to ensure that the light bulb selected for light logger monitoring in each room type was selected at random. For example, if the random number generated for a home was the number 12, then the GDS surveyor selected the 12th light bulb listed on the GDS survey inventory form and installed a light logger on that bulb. Using a random number generator ensured that GDS used a random process to select bulbs for monitoring, and removed any bias that could result if surveyors were allowed to select bulbs for monitoring based on each surveyor's preference. GDS selected a range of 10 to 25 for the random numbers as a reasonable range given that most homes will not have more than 15 light bulbs per room.

responsivity to light due to the presence of an adjustable dial to adjust for light sensitivity. To address these concerns, surveyors were carefully trained on proper logger installation and testing for sensitivity to ambient light. Surveyors were additionally trained to be cautious of installing loggers too close to bulbs radiating heat to prevent burning and melting of loggers. Loggers installed in exteriors were placed in plastic zip lock bags to protect them from the elements.

Logger Retrieval

Logger retrieval began several weeks after initial onsite visits began. The loggers were left in participating homes for an average of 49 days. Multiple efforts were taken to achieve maximal success in recovering the loggers. The GDS team was able to recover loggers from 65 (95%) of the 68 participating homes. Of the 449 loggers originally installed by GDS surveyors, 90% or 405 were successfully recovered. Of the recovered loggers, 5.7% had bad readings or the batteries were dead on pickup, so this data could not be used.

Data Cleaning and Analysis

After loggers had been retrieved from all surveyed homes, GDS employees conducted data extraction and cleaning of raw data recorded by the installed loggers. Loggers were excluded from analysis even if they were successfully retrieved for various reasons including observable heat damage and battery issues. Loggers were additionally excluded if they returned with no data recorded.

During review of the data, it was discovered that 70 light loggers had been reset to the original factory set date of January 1, 2001. After further research, GDS discovered this was due to the batteries being replaced in these light loggers. Fortunately, it was possible to change the start date and time for data logging to be correct. As a result, the data from these 70 loggers was able to be included in the calculation of the annual hours of use per day. Because the exact hour of the day of logger startup was not able to be set precisely, the data from these 70 loggers were not included in the calculations of the summer and winter peak coincidence factors.

Hours of Use (HOU) Modeling

Two analytical steps were taken by GDS to develop estimates of hours of use (HOU). First, the logger data was annualized since a full year of data was not captured. Next, a weighted hierarchical linear model was developed for HOU to estimate statewide HOU estimates by room type.

Loggers were not installed for a full calendar year, so a sinusoidal model was used to estimate daily HOU for missing dates for each logger.[34] A sinusoidal model, as described by the formula below, was fit to each logger's measured HOU data.

$$HOU_d = \beta_0 + \beta_1 \sin(\theta_d) + \varepsilon_d$$

EQUATION 7-1 SINUSOIDAL MODEL SPECIFICATION

Where:

HOU = hours of use

Θ = an angle, in radians, representing the amount of sunlight on the day. θ is 0 for the spring and autumnal equinoxes, π/2 for the winter solstice, and - π/2 for the summer solstice

d = the day of the year

β = regression coefficients

ε = error term

[34] The approach is consistent with the Uniform Methods Project for estimating lighting efficiency savings.

Consistent with the criteria set forth in the California Upstream Lighting evaluation[35] and the Northeast Residential Lighting HOU Study[36], sinusoidal models were deemed to be a poor fit if one of the following criteria were met:

- β1 coefficient has an absolute value greater than 10
- The standard error for β1 is greater than 1
- β0 is less than or equal to zero
- β0 is greater than 24

With these criteria, 30 of the 270 sinusoidal models were deemed to have a poor fit. For those loggers, many of which were in closets and basements with very erratic use, the average weekend HOU from the measure data was used to estimate weekend HOU for dates not in the sample and the average weekday HOU from the measure data was used to estimate weekday HOU for dates not in the sample.

Table 7-6 below shows the average annual and daily hours of use by room type, along with the number of light loggers that were successfully installed and used for the data analysis.

TABLE 7-6 HOURS OF USE BY ROOM TYPE

Room Type	Number of Loggers	Average Annual HOU	Average Daily HOU
Living Room	48	1,519.25	4.16
Kitchen	53	1,650.54	4.52
Bedroom	88	746.03	2.04
Bathroom	46	730.08	2.00
Other Internal	47	986.79	2.70
External	25	1,397.74	3.83
Whole House Total	**307**	**1,118.12**	**3.06**

Coincidence Factor (CF) Modeling

The coincidence factor (CF) for residential lighting is a measure of the percent of light bulbs turned on during a defined peak hour period.[37] Utility planners define "**coincidence factor**" as the ratio of the **coincident**, maximum demand of two or more electric loads to the sum of their noncoincident maximum demand for a given period.

Average CF was calculated for each light logger and a hierarchical model was then developed to estimate average CF by room type and bulb type. The following equation represents the hierarchical linear model that was used to calculate CF in this study. The 70 loggers where the time clocks were reset were not included in the coincidence factor calculations, as we cannot certify the exact hour of the day that the loggers were installed.

$$CF_{h,i} = (\beta_0 + b_{0,h}) + \beta_1 I_{EFF} + \sum_r (\beta_r + b_{r,h}) I_r + \varepsilon_{h,i}$$

[35] KEMA, Inc. and the Cadmus Group, Inc. *Final Evaluation Report: Upstream Lighting Program Volume I*. Prepared for California Public Utilities Commission, Energy Division. February 8, 2010.
[36] NMR Group, Inc. and DNV GL. *Northeast Residential Lighting Hours-of-Use Study*. May 5, 2014.
[37] Based on GDS' analysis of historical peak load data for Maine, GDS determined that the summer peak in Maine usually occurs on day 195 (July 15th) of a year. GDS also determined that the summer peak usually occurs in the hour ending 15:00 (ET) or 17:00 (ET). The winter peak in Maine usually occurs on day 15 (January 15th) in the hour ending 18:00 (ET). Historic peak load data for Maine may be found at: https://www.iso-ne.com/search?query=maine%20peak%20load.

EQUATION 7-2 HIERARCHICAL LINEAR MODEL FOR CF

Where :

$b_{o,h} \sim N(b_h, \sigma^2_{b_h})$
$b_{r,h} \sim N(0, \sigma^2_h)$
CF = coincidence factor
h = index for home
i = index for logger
r = index for room type
I_{EFF} = indicator variable for efficient bulb type
I_r = indicator variable for room type
β_x = fixed effects coefficients
$B_{x,h}$ = random effects coefficients
ε = error term

Tables 7-7 and 7-8 provide summer and winter coincidence factors for the residential light bulbs monitored in this light logger study. These coincidence factors represent the percent of residential light bulbs turned on at the time of the summer and winter peak load hour in Maine. The summer coincidence factor is 13.2% and the winter coincidence factor is 13.8%.

TABLE 7-7 SUMMER COINCIDENCE FACTORS BY ROOM TYPE

Room Type	Number of Loggers	Summer Coincidence Factor
Living Room	36	0.129
Kitchen	42	0.192
Bedroom	72	0.101
Bathroom	39	0.113
Other Internal	39	0.107
External	24	0.224
Whole House Total	**252**	**0.132**

TABLE 7-8 WINTER COINCIDENCE FACTORS BY ROOM TYPE

Room Type	Number of Loggers	Winter Coincidence Factor
Living Room	36	0.158
Kitchen	42	0.210
Bedroom	72	0.078
Bathroom	39	0.103
Other Internal	39	0.136
External	24	0.168
Whole House Total	**252**	**0.138**

8 Building Envelope

This section of the baseline study report presents information on the types and amount of insulation in the attics, walls, floors and basement walls of the surveyed LIHEAP homes.

The presence of insulation in side walls of a home is difficult to measure directly as the only definitive way to measure the amount of insulation in a wall cavity directly is by drilling through a portion of a wall. GDS surveyors used two non-invasive methods to collect information on the type and amount of wall insulation:

1. Homeowners were asked by GDS surveyors to report whether or not they thought side wall insulation was present
2. After collecting the homeowner's response, GDS surveyors collected R-values using Testo electronic measurement equipment that enabled collection of R-values for walls in a non-invasive manner. GDS surveyors were able to observe insulation levels in attics, floors and foundation walls in most instances through direct observation.

Table 8-1 presents a comparison of the average R-values in the surveyed LIHEAP homes in the 2018 Maine OPA study versus values reported for all single-family homes in Maine surveyed in the 2015 Statewide Study. Average R-values are also provided across all homes.

GDS surveyors were able to determine insulation R-values in walls for 60 of the 68 (88.2%) homes. Of these 60 R-values, 51 were determined by GDS to be reliable measurements and were retained in the data presented in this baseline study. The average R-value for walls presented in Table 8-1 was calculated for those homes where wall insulation was able to be assessed with the electronic measurement equipment. The average R-value for insulation in roof cavities, frame floors and foundation walls are based on measurements and observations made by GDS surveyors through direct viewing of the insulation in these areas of homes.

TABLE 8-1 AVERAGE INSULATION LEVELS FOR HOMES WITH INSULATION

	2015 Statewide Study			2018 LIHEAP Study			
	Number of Homes with Insulation Present	Percent of Homes with Insulation Present	Average R-Value	Number of Homes with Insulation Present	Percent of Homes with Insulation Present [38]	Average R-Value for Homes with Insulation Present	Average R-Value for All Homes [39]
Insulation in Side Walls	41	93.2%	R-13 [40]	41 [41]	68.3% [42]	R-10 [43]	R-7
Insulation in Roof Cavity	40	90.9%	R-26	47	69.1%	R-30	R-20
Insulation for Frame Floors Over Unheated Basements	6	13.6%	R-3	3	4.4%	R-17	R-4
Insulation for Frame Floors Over Heated Basements	-	-	-	5	7.4%	R-18	R-9
Insulation in Foundation Walls in Heated Space	12	27.3%	R-5	13	19.1%	R-16	R-3

[38] GDS surveyors used three methods to determine the presence of wall insulation: direct observation, responses from household occupants, or up to one-hour measurement with Testo electronic measurement equipment. GDS surveyors recorded whether insulation was present in a ceiling, wall, floor or foundation wall.

[39] Average R-values across all homes were calculated including homes in which no insulation was observed, but the following were present: side walls, roof cavities, frame floors over unheated basements, frame floors over heated basements, and foundation walls in heated space.

[40] The wall insulation R-values reported in the 2015 statewide study only reflect the R-value for the insulation in the wall cavity and does not include other building shell components such as sheathing, sheet rock, or siding.

[41] This average R-values reported in this row of the Table for wall insulation are based on the measurements done with the Testo electronic measurement equipment.

[42] Based on the percentage of the 60 homes (the homes where R values were measured with Testo equipment) that have insulation in the wall cavity.

[43] Exterior wall insulation R-value determined through measurement with Testo electronic equipment.

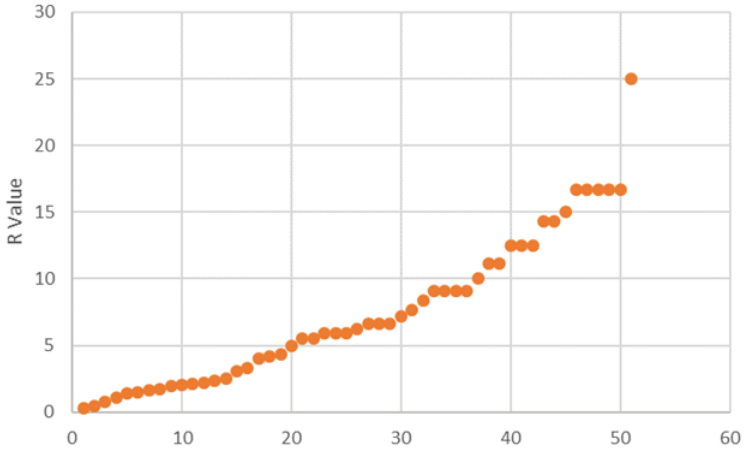
Figure 8-1 shows a plot of the R-values measured in 2018 by GDS in the walls of the 68 surveyed LIHEAP homes. GDS obtained valid wall insulation R-value measurements for 60 homes. GDS used special electronic measurement equipment to measure R-values of wall insulation in the surveyed homes. This special measurement equipment included the following measurement devices:

- ***Testo electronic hygrometers***
- ***Wire-based interior temperature sensor to measure the inside temperature of walls in a home***
- ***Wireless probe to measure outside temperature***

GDS used the hygrometer and the temperature probes as a system to measure and calculate wall insulation R-values.

The results of the Testo hygrometer measurements found that 36 of the 68 (52.9%) Maine LIHEAP homes had wall insulation R-values of less than R-10 and could benefit from additional wall insulation. GDS notes that there were a few homes with measurements above R-30 for wall insulation- these values are clearly outliers. GDS has excluded these measurements from the reported data on wall insulation levels.

FIGURE 8-1 TESTO R-VALUES FOR SIDE WALLS



Note: The X axis is the rank order of the wall insulation R-value level, ranked from lowest R-value to highest R-value for all 68 surveyed homes. Instances above R-30 were determined to be outliers and not were not considered in this analysis.

Table 8-2 below displays the frequency of Testo R-values for wall insulation observed in the 68 surveyed homes.

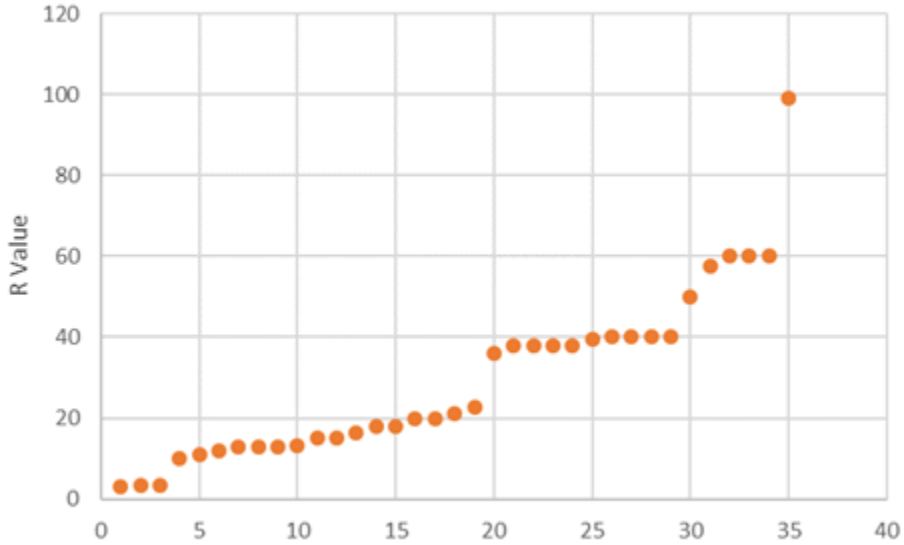
TABLE 8-2 TESTO R-VALUES FOR SIDE WALLS [44]

TESTO R-Value	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0 - 5	20	33.3%	20	33.3%
5.01 - 10	17	28.3%	37	61.7%
10.01 - 15	8	13.3%	45	75.0%
15.01 - 20	5	8.3%	50	83.3%
20.01 – 25	1	1.7%	51	85.0%
25.01 – 30	0	0%	51	85.0%
30.01 – 35	3	5.0%	54	90.0%
Greater than 35	6	10.0%	60	100.0%

[44] The Testo measurement equipment measures the wall R-value using 3 surface temperature probes on an inside wall and 1 outdoor temperature probe. GDS only took the wall R-value measurement of one wall at each home surveyed.

Figure 8-2 shows a graph of the observed attic insulation R-values in the surveyed LIHEAP homes. Many LIHEAP homes either have no attic insulation or have attic insulation levels that are below current minimum standards for energy efficient residential construction in Maine. The International Energy Conservation Code (IECC) requirement for Maine for attic insulation for energy efficient residential construction is R-49. Nine percent (8.8%) of surveyed LIHEAP homes reported an attic insulation value of R-49 or higher.

FIGURE 8-2 R-VALUES FOR ATTIC INSULATION



NOTE: The X axis is the rank order of the attic insulation R-value level, ranked from lowest R-value to highest R-value for 35 homes out of 47 homes with existing attic insulation. GDS surveyors at the remaining 12 homes with existing attic insulation were not able to determine the R-value of existing attic insulation. Over 80% (82.9%) of surveyed homes with reliable R values for attic insulation failed to meet the recommended IECC R-value of R-49

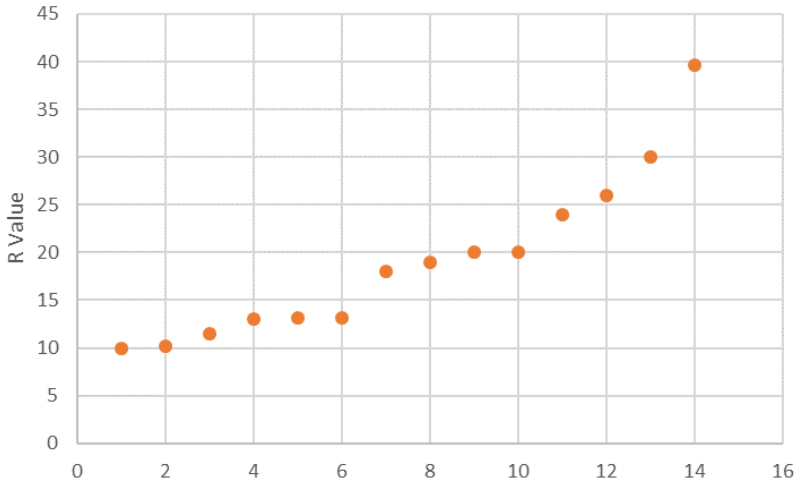
Table 8-3 provides summary information on attic insulation values from the 2015 Maine Statewide Study and from the 2018 LIHEAP Study. The following table provides information for all 68 homes surveyed- no homes surveyed indicated not having an attic. For LIHEAP homes having attic insulation that is observable, the average R-value of that attic insulation in LIHEAP homes is R-30 for homes with attic insulation, slightly higher than that of all single-family residential homes in Maine. Across all homes including homes without attic insulation, the average R-value is R-26.

TABLE 8-3 R-VALUES FOR ATTIC INSULATION (2018 SURVEYOR OBSERVATION VALUES)

	2015 Statewide Study	2018 LIHEAP Study – Average R-Value for Homes with Insulation Present	2018 LIHEAP Study – Average R-Value for All Homes
Open Attic Average R-Value	R-29	R-30	R-26
Number of Homes with Attic Insulation	40	47	
Number of Homes with No Attic Insulation	1	5	
Unable to Determine	0	16	
Total	**41**	**68**	

Figure 8-3 shows a graph of R-values for floor frame insulation over both heated and unheated basements in the surveyed LIHEAP homes.

FIGURE 8-3 R-VALUES FOR FLOOR FRAME INSULATION OVER ALL BASEMENTS



NOTE: The X axis is the rank order of the floor frame insulation R-value level, ranked from lowest R-value to highest R-value for 14 homes out of 23 homes with floor frames over basements in which floor frame insulation values were able to be determined. GDS surveyors at the remaining homes with existing floor frame insulation over basements reported not being able to determine the R-value of existing floor frame insulation.

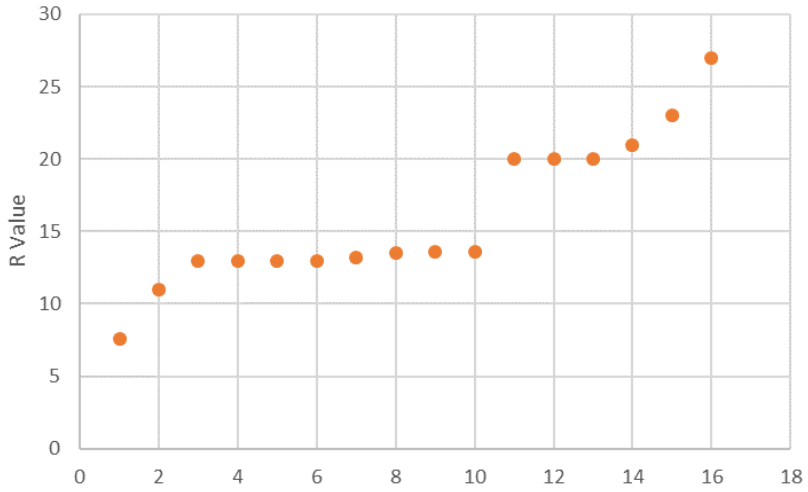
Table 8-4 details the average R-values for floor frame insulation over unheated basements for both homes with existing foundation wall insulation present over unheated basements and for all homes with unheated basements regardless of insulation level, in addition to the breakdown of LIHEAP homes with unheated basements. For homes with existing floor frame insulation, the average R-value of R-17 is significantly higher than the 2015 baseline of R-3. When comparing across all homes with unheated basements however, the average insulation level is R-4- much closer to the 2015 baseline. The large difference in calculated average R-values suggests that LIHEAP homes with existing floor insulation over unheated basements are insulated moderately-well, but that a large number of LIHEAP homes do not have existing frame floor insulation over unheated basements and may stand to gain from additional insulation.

TABLE 8-4 R-VALUES FOR FLOOR FRAME INSULATION OVER UNHEATED BASEMENTS

	2015 Statewide Study	2018 LIHEAP Study – Average R-Value for Homes with Insulation Present	2018 LIHEAP Study – Average R-Value for All Homes
Floor Insulation Over Unheated Basements Average R-Value	R-3 [45]	R-17	R-4
Number of Homes with Unheated Basements	24	23	
Number of Homes with Floor Insulation Over Unheated Basements	6	3	
Number of Homes with Unheated Basements and No Floor Insulation	18	18	
Number of Homes with Unheated Basements, Unable to Determine Floor Insulation	0	2	

Figure 8-4 shows a graph of R-values for foundation wall insulation over both heated and unheated basements in the surveyed LIHEAP homes.

FIGURE 8-4 R-VALUES FOR FOUNDATION WALL INSULATION OVER ALL BASEMENTS



NOTE: The X axis is the rank order of the foundation wall insulation R-value level, ranked from lowest foundation wall insulation R-value to highest R-value for 16 homes out of 24 homes with existing foundation walls over heated basements. GDS surveyors at the remaining 8 homes with foundation wall insulation over basements reported not being able to determine the R-value of existing attic insulation.

Table 8-5 details the average R-values for foundation wall insulation over heated basements for both homes with foundation wall insulation present over heated basements and for all homes with heated basements regardless of insulation level, in addition to the breakdown of LIHEAP homes with heated basements. As shown below, the average R-value for foundation wall insulation over heated basements for homes with existing insulation, R-16, is significantly higher than that of the 2015 baseline study. When compared to the average R-value across all homes with heated basements however, the 2018 findings for foundation wall insulation is lower than the baseline,

[45] The 2015 NMR study does not state if the reported R-3 insulation value includes homes with unheated basements and no floor insulation.

suggesting the LIHEAP homes with existing foundation wall insulation over heated basements are moderately insulated, but that a large number of LIHEAP homes do not have existing frame floor insulation over heated basements.

TABLE 8-5 R-VALUES FOR FOUNDATION WALL INSULATION OVER HEATED BASEMENTS

	2015 Statewide Study	2018 LIHEAP Study – Average R-Value for Homes with Insulation Present	2018 LIHEAP Study – Average R-Value for All Homes
Insulation of Foundation Walls of Heated Basements Average R-Value	R-5 [46]	R-16	R-3
Number of Homes with Heated Basements	19	24	
Number of Homes with Foundation Wall Insulation in Heated Basements	12	13	
Number of Homes with Heated Basements and no Foundation Wall Insulation	7	8	
Number of Homes with Heated Basements, Unable to Determine Wall Insulation	0	3	

Table 8-6 provides information on the frequency of types of window paning observed in the 68 surveyed homes. A total of 1,123 windows were observed in all surveyed homes. The majority of all observed windows (62.5%) were double-paned windows. Single-pane windows characterized 20.4% of all observed windows and triple-pane windows characterized 17.1%.

TABLE 8-6 WINDOW PANING

	Frequency	Percent of Total Windows
Single Pane	229	20.4%
Double Pane	702	62.5%
Triple Pane	192	17.1%

Table 8-7 provides information on the number of homes with at least one window with the following types of glazing: storm, low-E, and argon-filled. Fourteen of the 68 homes (20.6%) had at least one storm window, 17 homes (25.0%) had at least one low-E window, and 7 homes (10.3%) had at least one argon-filled window.

TABLE 8-7 WINDOW GLAZING

	Number of Homes with at Least One Present	Percent of Homes with at Least One Present
Storm Window	14	20.6%
Low-E Window	17	25.0%
Argon-Filled Window	7	10.3%

[46] The 2015 statewide study does not state if the reported average R-5 insulation value for foundation walls includes homes with heated basements that do have insulation for foundation walls.

Table 8-8 provides information on the material composition of window sashes observed in the 68 surveyed homes. The majority of homes (50.0%) had windows with vinyl sashes, followed by 22.1% with wooden sashes. Twelve percent (11.8%) of homes had windows with metal sashes. The remaining sashes were composites of vinyl, wood, and metal.

TABLE 8-8 WINDOW SASH MATERIAL

Material	Frequency	Percent
Wood	15	22.1%
Vinyl	34	50.0%
Metal	8	11.8%
Vinyl/Wood	5	7.4%
Vinyl/Metal	3	4.4%
No Response	3	4.4%
Total	**68**	**100.0%**

9 Air Sealing & Duct Sealing

This section of the report provides information on the presence of proper air sealing of the home and proper sealing and insulation of heating and cooling ductwork in Maine LIHEAP homes.

Table 9-1 provides information on the condition of air sealing observed [47] in surveyed LIHEAP homes. GDS surveyors observed that 41.5% of air sealing in homes surveyed in 2018 were observed to be partially sealed and 27.7% were observed to be well-sealed. Nineteen percent (18.5%) of surveyed air sealing was observed to be poorly sealed. Sixty percent (60.0%) of homes were either partially or poorly sealed. GDS surveyors did not report the condition of air sealing in 12.3% of surveyed homes.

TABLE 9-1 QUALITY OF AIR SEALING

Quality of Sealing	Number of LIHEAP Homes in Category	2018 LIHEAP Study
Well-Sealed	18	27.7%
Partially Sealed	27	41.5%
Poorly Sealed	12	18.5%
Unable to Assess	8	12.3%
Total Responses	**65**	**100.0%**
Missing Responses = 3		

Table 9-2 provides the frequency of fireplaces observed in surveyed LIHEAP homes. The majority of surveyed homes (92.4%) had no fireplaces in their homes and only 5 respondents (7.6%) had one fireplace. Only 1 of the 5 homes with a fireplace reported using the fireplace for space heating.

TABLE 9-2 NUMBER OF FIREPLACES IN THE HOME

Frequency	Number of LIHEAP Homes in Category	2018 LIHEAP Study Percent of Total
0	61	92.4%
1	5	7.6%
Total Responses	**66**	**100.0%**
Missing Responses = 2		

Table 9-3 provides information on the presence of fireplace dampers in the 5 homes with fireplaces of the 68 surveyed homes. One-hundred percent (100%) of homes with fireplaces reported also having a damper present.

TABLE 9-3 NUMBER OF FIREPLACES IN THE HOME WHERE DAMPER IS PRESENT

	Number of LIHEAP Homes in Category	2018 LIHEAP Study Percent of Total
Damper Present	5	100%
Damper Not Present	0	0%
Total Responses	**5**	**100%**

[47] GDS surveyors used their professional experience and training to determine the condition of air sealing at each surveyed home.

Table 9-4 provides information on the presence of ductwork in the 68 surveyed homes. Thirty-one of the 68 surveyed homes (46.3%) had no existing HVAC ductwork. This is partially due to the fact that 16 of the 68 homes (23.5%) use fossil-fueled boilers (boilers do not use ductwork to distribute heat) for space heating.

TABLE 9-4 PRESENCE OF DUCTWORK IN THE HOME

	Number of LIHEAP Homes in Category	2018 LIHEAP Study - Percent of Total
Ductwork Present	35	52.2%
Ductwork Not Present	31	46.3%
Unable to Assess	1	1.5%
Total Responses	**67**	**100.0%**
Missing Responses = 1		

Tables 9-5 to 9-9 present information on ductwork conditions. These tables exclude information from 31 of the 68 homes in which no ductwork was present.

Table 9-5 provides information on the location of ductwork for the surveyed LIHEAP homes. GDS surveyors found that 51.4% of respondents have ductwork located in unconditioned space while 48.6% of homes have ductwork located in conditioned space.

TABLE 9-5 DUCTWORK IN CONDITIONED VS. NON-CONDITIONED SPACE

	Number of LIHEAP Homes in Category	2018 LIHEAP Study - Percent of Total
Ductwork Located in Conditioned Space	17	48.6%
Ductwork Located in Non-Conditioned Space	18	51.4%
Unable to Assess	0	0%
Total Responses (for ductwork present only)	**35**	**100.0%**

Table 9-6 provides information on the quality of duct sealing for ductwork observed for surveyed homes with ductwork present. Forty percent (40.0%) of homes with ductwork exhibited minimal signs of observable sealing leaks and 17.1% exhibited some signs of observable leaks. Only 2.9% of homes with ductwork exhibited signs of significant to catastrophic sealing leaks. GDS surveyors were not able to assess the quality of existing ductwork sealing in 14 homes.

TABLE 9-6 QUALITY OF DUCTWORK SEALING

Quality of Sealing	Number of LIHEAP Homes in Category	2018 LIHEAP Study – Percent of Total
Sealed with Mastic	3	8.6%
No Observable Leaks	11	31.4%
Some Observable Leaks	6	17.1%
Significant Leaks	0	0%
Catastrophic Leaks	1	2.9%
Unable to Assess	14	40.0%
Total Responses	**35**	**100.0%**

Table 9-7 provides information on the percentages of existing ductwork within the conditioned envelope in the 68 surveyed homes. Seventy-seven percent (76.5%) of homes with ductwork within the conditioned envelope had at least 90% of existing ductwork located within the conditioned envelope. Twelve percent (11.8%) had less than 50%

of existing ductwork located within the conditioned envelope. GDS surveyors were unable to assess the percentage of ductwork within the conditioned envelope for an additional 11.8%.

TABLE 9-7 PERCENT OF DUCTWORK WITHIN CONDITIONED ENVELOPE

	Number of LIHEAP Homes in Category	2018 LIHEAP Study
90% or More of Ductwork within Conditioned Envelope	13	76.5%
Less Than 50% within Conditioned Envelope	2	11.8%
Unable to Assess	2	11.8%
Total Responses	**17**	**100.0%**

Table 9-8 provides information on ranges of insulation levels of ductwork located outside of conditioned space. No homes with existing ductwork exhibited ductwork insulation levels of R-4 or greater. Sixty-seven percent (67%) of respondents having ductwork outside of the conditioned envelope did not have any insulation on heating ductwork. Surveyors were not able to assess the quality of duct sealing in 54% of the surveyed homes.

TABLE 9-8 DUCTWORK INSULATION LEVELS OUTSIDE OF CONDITIONED ENVELOPE

Insulation Level of Ductwork	Number of LIHEAP Homes in Category	2018 LIHEAP Study
R-8 or Greater	0	0.0%
R-4 to R-7	0	0.0%
Less than R-4	6	33.3%
Not Insulated	12	66.7%
Unable to Assess	0	0.0%
Total Responses	**18**	**100.0%**

Table 9-9 provides information on the locations of existing ductwork outside the conditioned envelope in the 68 surveyed homes. GDS surveyors observed that seventeen homes had existing ductwork located in conditioned space. In 18 homes, ductwork is installed outside of the conditioned envelope. The unconditioned spaces with ductwork include unconditioned basements, crawl spaces, and attics.

TABLE 9-9 LOCATION OF DUCTWORK OUTSIDE OF CONDITIONED ENVELOPE

	Number of LIHEAP Homes in Category	2018 LIHEAP Study
Unconditioned Basement	6	33.33%
Crawl Space	5	27.8%
Attic	0	0%
Unable to Assess	7	38.9%
Total Responses	**18**	**100.0%**

10 Major Appliances

This section provides data on the percentage of surveyed LIHEAP households possessing at least one of various appliances, the frequency of appliances observed, the frequency of equipment servicing, the percent saturation of appliances, and comparisons of 2018 LIHEAP appliance saturations with 2015 baseline study appliance saturations. This study collected data for all appliances included in the 2015 baseline study, as well as various additional appliances for the purpose of thoroughness. For this section of the report, GDS has added data to tables for the cumulative percent of homes determined to have one, two, three, or more of a specific appliance. This additional information can be helpful when planning electric appliance energy efficiency programs.

Table 10-1 below displays the frequency of refrigerators observed in surveyed homes. One hundred percent (100%) of surveyed homes had at least one refrigerator, matching the 2015 baseline reporting.

TABLE 10-1 NUMBER OF REFRIGERATORS IN THE HOME

Number of Refrigerators	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	61	89.7%	61	89.7%
2	5	7.4%	66	97.1%
3	2	2.9%	68	100.0%

Table 10-2 below displays the frequency of freezers observed in surveyed homes. Forty-seven (47.0%) of surveyed homes had at least one freezer, the same as the 2015 baseline of 47%. Fifty-three percent (53.0%) of homes had no freezers, 39.4% had 1 freezer and 7.6% had two freezers.

TABLE 10-2 NUMBER OF FREEZERS IN THE HOME

Number of Freezers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	35	53.0%	35	53.0%
1	26	39.4%	61	92.4%
2	5	7.6%	66	100%
Missing Observations = 2				

Table 10-3 and 10-4 below display the primary fuel type for ovens and stove tops respectively in surveyed LIHEAP homes. Sixty-nine percent (69.1%) of surveyed homes have electric ovens and stove tops, followed by 26.5% of ovens and stove tops fueled by propane, and only 4.4% fueled by natural gas.

TABLE 10-3 OVEN FUEL TYPE

Fuel Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Electric	47	69.1%	47	69.1%
Natural Gas	3	4.4%	50	73.5%
Propane	18	26.5%	68	100.0%

TABLE 10-4 STOVE TOP FUEL TYPE

Fuel Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Electric	47	69.1%	47	69.1%
Natural Gas	3	4.4%	50	73.5%
Propane	18	26.5%	68	100.0%

Table 10-5 below displays the frequency of dishwashers observed in surveyed homes. Forty-nine percent (48.5%) of surveyed homes had at least one dishwasher, slightly higher than the 2015 baseline of 47%. No homes surveyed possessed more than one dishwasher.

TABLE 10-5 NUMBER OF DISHWASHERS IN THE HOME

Number of Dishwashers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	35	51.5%	35	51.5%
1	33	48.5%	68	100.0%

Table 10-6 below displays the frequency of clothes washers observed in surveyed homes. Ninety percent (89.7%) of surveyed homes had at least one clothes washer, significantly above the 2015 baseline of 52%. No homes surveyed possessed more than one clothes washer.

TABLE 10-6 NUMBER OF CLOTHES WASHERS IN THE HOME

Number of Clothes Washers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	7	10.3%	7	10.3%
1	61	89.7%	68	100.0%

Table 10-7 below displays the frequency of clothes dryers observed in surveyed homes. Eighty-five (85.3%) of surveyed homes had at least one clothes dryers, significantly above the 2015 baseline of 35%. No homes surveyed possessed more than one clothes dryer.

TABLE 10-7 NUMBER OF CLOTHES DRYERS IN THE HOME

Number of Clothes Dryers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	10	14.7%	10	14.7%
1	58	85.3%	68	100.0%

Table 10-8 below displays the frequency of televisions observed in surveyed homes. Ninety-seven percent (97%) of surveyed homes had at least one television. Eighty-one percent (80.9%) of all surveyed homes possessed 1 to 3 televisions. No homes surveyed possessed more than 5 televisions.

TABLE 10-8 NUMBER OF TELEVISIONS IN THE HOME

Number of Televisions	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	2	2.9%	2	2.9%
1	16	23.5%	18	26.5%
2	27	39.7%	45	66.2%
3	12	17.7%	57	83.8%
4	7	10.3%	64	94.1%
5	4	5.9%	68	100.0%

Table 10-9 below displays the frequency of desktop computers observed in surveyed homes. Sixty-six percent (65.7%) of surveyed homes did not have any desktop computers. Thirty-four percent (34.3%) of surveyed homes had at least one desktop computer. Seventy-four percent (73.9%) of homes with at least one desktop computer possessed only one. No homes surveyed possessed more than 2 desktop computers.

TABLE 10-9 NUMBER OF DESKTOP COMPUTERS IN THE HOME

Number of Desktop Computers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	44	65.7%	44	65.7%
1	17	25.4%	61	91.0%
2	6	9.0%	67	100.0%
Missing Responses = 1				

Table 10-10 below displays the frequency of laptops observed in surveyed homes. Fifty-six percent (55.9%) of surveyed homes had at least one laptop. Sixty-three percent (63.1%) of homes with at least one laptop possessed only one. No homes surveyed possessed more than 3 laptop computers.

Twenty of the 68 homes (29.4%) had neither a desktop or laptop computer present.

TABLE 10-10 NUMBER OF LAPTOPS IN THE HOME

Number of Laptops	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	30	44.1%	30	44.1%
1	24	35.3%	54	79.4%
2	10	14.7%	64	94.1%
3	4	5.9%	68	100.0%

Table 10-11 displays the frequency of tablet devices observed in surveyed homes. Thirty-five percent (34.8%) of surveyed homes had at least one tablet device. Of homes with at least one tablet device, 56.5% possessed only one. No homes surveyed possessed more than 3 tablet devices.

Seventeen of the 68 homes (25.0%) had neither a desktop, laptop, or tablet device present.

TABLE 10-11 NUMBER OF TABLET DEVICES IN THE HOME

Number of Tablet Devices	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	43	65.2%	43	65.2%
1	13	19.7%	56	84.9%
2	8	12.1%	64	97.0%
3	2	3.0%	66	100.0%
Missing Responses = 2				

Table 10-12 below displays the frequency of VCRs observed in surveyed homes. Thirty percent (30.3%) of surveyed homes had at least one VCR. No homes surveyed possessed more than one VCR.

TABLE 10-12 NUMBER OF VCRS IN THE HOME

Number of VCRs	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	46	69.7%	46	69.7%
1	20	30.3%	66	100.0%
Missing Observations = 2				

Table 10-13 below displays the frequency of DVD/Blu-Ray players observed in surveyed homes. Seventy percent (69.7%) of surveyed homes had at least one DVD/Blu-Ray player. Seventy-eight percent (78.3%) of surveyed homes with at least one DVD/Blu-Ray player possessed only one. No homes surveyed possessed more than 5 DVD/Blu-Ray players.

TABLE 10-13 NUMBER OF DVD/BLU-RAY PLAYERS IN THE HOME

Number of DVD/Blu-Rays	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	20	30.3%	20	30.3%
1	36	54.6%	56	84.9%
2	6	9.1%	62	93.9%
3	3	4.6%	65	98.5%
5	1	1.5%	66	100.0%
Missing Observations = 2				

Table 10-14 below displays the frequency of electronic gaming systems observed in surveyed homes. Thirty-three (33.3%) of surveyed homes had at least one electronic gaming system. Sixty-four percent (63.6%) of surveyed homes with at least one gaming system possessed only one. No homes surveyed possessed more than 6 gaming systems.

TABLE 10-14 NUMBER OF GAMING SYSTEMS IN THE HOME

Number of Gaming Systems	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	44	66.7%	44	66.7%
1	14	21.2%	58	87.9%
2	3	4.6%	61	92.4%
3	3	4.6%	64	97.0%
5	1	1.5%	65	98.5%
6	1	1.5%	66	100.0%
Missing Observations = 2				

Table 10-15 below displays the frequency of stereo systems observed in surveyed homes. Twenty-five (24.6%) of surveyed homes had at least one stereo system. Eighty-eight percent (87.5%) of surveyed homes with at least 1 stereo system possessed only 1.

TABLE 10-15 NUMBER OF STEREO SYSTEMS IN THE HOME

Number of Stereo Systems	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	49	75.4%	49	75.4%
1	14	21.5%	63	96.9%
2	2	3.1%	65	100%
Missing Observations = 3				

Table 10-16 below displays the frequency of cell phone chargers observed in surveyed homes. Seventy-nine percent (78.8%) of surveyed homes had at least one cell phone charger. Sixty-seven percent (67.3%) of surveyed homes with at least one cell phone charger had 1 or 2 chargers. No homes surveyed possessed more than 6 chargers.

TABLE 10-16 NUMBER OF CELL PHONE CHARGERS IN THE HOME

Number of Cell Phone Chargers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	14	21.2%	14	21.2%
1	19	28.8%	33	50.0%
2	16	24.2%	49	74.2%
3	8	12.1%	57	86.4%
4	3	4.6%	60	90.9%
5	3	4.6%	63	95.5%
6	3	4.6%	66	100%
Missing Observations = 2				

Table 10-17 below displays the frequency of theater systems observed in surveyed homes. Only 4.6% of surveyed homes had at least one home theater system. No homes surveyed possessed more than one theater system.

TABLE 10-17 NUMBER OF THEATER SYSTEMS IN THE HOME

Number of Theater Systems	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	62	95.4%	62	95.4%
1	3	4.6%	65	100%
Missing Observations = 3				

Table 10-18 below displays the frequency of fax machines observed in surveyed homes. Only 9.2% of surveyed homes had at least fax machine. No homes surveyed possessed more than one fax machine.

TABLE 10-18 NUMBER OF FAX MACHINES IN THE HOME

Number of Fax Machines	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	59	90.8%	59	90.8%
1	6	9.2%	65	100%
Missing Observations = 3				

Table 10-19 below displays the frequency of dehumidifiers observed in surveyed homes. Twenty percent (19.7%) of surveyed homes had at least one dehumidifier, lower than the 2015 baseline of 28%. No homes surveyed possessed more than 2 dehumidifiers.

TABLE 10-19 NUMBER OF DEHUMIDIFIERS IN THE HOME

Number Dehumidifiers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	56	80.3%	56	80.3%
1	7	12.1%	63	92.4%
2	2	7.6%	65	100%
Missing Observations = 3				

Table 10-20 below displays the frequency of humidifiers observed in surveyed homes. Fourteen percent (13.9%) of surveyed homes had at least one humidifier. No homes surveyed possessed more than 2 humidifiers.

TABLE 10-20 NUMBER OF HUMIDIFIERS IN THE HOME

Number of Humidifiers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	56	86.2%	56	86.2%
1	7	10.8%	63	96.9%
2	2	3.1%	65	100%
Missing Observations = 3				

Table 10-21 below displays the frequency of air purifiers observed in surveyed homes. Fourteen percent (13.8%) of surveyed homes had at least one air purifier. No homes surveyed possessed more than 3 air purifiers.

TABLE 10-21 NUMBER OF AIR PURIFIERS SYSTEMS IN THE HOME

Number of Air Purifiers	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	56	86.2%	56	86.2%
1	7	10.8%	63	96.9%
2	1	1.5%	64	98.5%
3	1	1.5%	65	100.0%
Missing Observations = 3				

Table 10-22 below displays the frequency of ceiling fans observed in surveyed homes. Seventy-one percent (70.6%) of surveyed homes had at least one ceiling fan. No homes surveyed possessed more than 5 ceiling fans.

TABLE 10-22 NUMBER OF CEILING FANS IN THE HOME

Number of Ceiling Fans	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	20	29.4%	20	29.4%
1	23	33.8%	43	63.2%
2	15	22.1%	58	85.3%
3	3	4.4%	61	89.7%
4	6	8.8%	67	98.5%
5	1	1.5%	68	100.0%

Table 10-23 below displays the frequency of portable fans observed in surveyed homes. Eighty-six percent (86.4%) of surveyed homes had at least one portable fan. No homes surveyed possessed more than 5 portable fans.

TABLE 10-23 NUMBER OF PORTABLE FANS IN HOME

Number of Portable Fans	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	9	13.6%	9	13.6%
1	19	28.8%	28	42.4%
2	20	30.3%	48	72.7%
3	13	19.7%	61	92.4%
4	4	6.1%	65	98.5%
5	1	1.5%	66	100.0%
Missing Observations = 2				

Table 10-24 below displays the frequency of well pump horsepower sizes observed in surveyed homes. Twenty-one of the surveyed homes (30.9%) had at least one well pump.

TABLE 10-24 SIZE OF WELL PUMPS IN THE HOME

Size Pump (HP)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0.5	12	17.7%	12	17.7%
0.75	1	1.5%	13	19.1%
1	8	11.8%	21	30.9%
Don't Know	8	11.8%	29	42.7%
No Well Pump Reported	39	57.4%	68	100.0%

Table 10-25 below displays the frequency of pool pump horsepower sizes observed in surveyed homes. Only 1 of the 68 surveyed homes had a swimming pool pump.

TABLE 10-25 SIZE OF POOL PUMPS IN THE HOME

Pump Size (HP)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1.5	1	100.0%	1	100.0%
Missing Responses = 31				

Table 10-26 below displays the frequency of heated in-ground pools observed in surveyed homes. Only 1 home had an in-ground pool. No homes surveyed had heated in-ground pools.

TABLE 10-26 HEATING OF IN-GROUND POOLS IN THE HOME

Number	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No Heated In-Ground Pool Reported	68	100.0%	68	100.0%

Table 10-27 below displays the frequency of heated above-ground pools observed at surveyed homes. Only 2 of the 68 surveyed homes (2.9%) had above-ground pools. Only 1 of these 2 homes reported heating their above-ground pools.

TABLE 10-27 HEATING OF ABOVE-GROUND POOLS IN THE HOME

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Above-Ground Pool, Heated	1	1.5%	1	1.5%
Above-Ground Pool, Unheated	1	1.5%	2	3.0%
No Above-Ground Pool Reported	66	97.0%	68	100.0%

Table 10-28 below displays the frequency of hot tubs observed in surveyed homes. Only 1 home of the 68 surveyed homes (1.5%) had a hot tub.

TABLE 10-28 HEATING OF HOT TUBS IN THE HOME

Heated Hot Tub(s)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Hot Tub, Heated	1	1.5%	1	1.5%
Hot Tub, Unheated	0	0%	1	1.5%
No Hot Tub Reported	67	98.5%	68	100.0%

Table 10-29 below displays the frequency of central air conditioning units observed in surveyed homes. Only 3 surveyed homes (4.4%) had central air conditioning and no homes surveyed had more than one CAC unit.

TABLE 10-29 NUMBER OF CENTRAL AIR CONDITIONING UNITS IN THE HOME

Number CAC Units	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	65	95.6%	65	95.6%
1	3	4.4%	68	100.0%

Table 10-30 below displays the frequency of water heating units observed in surveyed homes. Ninety-three percent (92.6%) of surveyed homes had at least one water heating unit. Ninety-seven percent (96.8%) of homes with at least one water heating unit had only one unit. No homes surveyed had more than 2 water heating units.

TABLE 10-30 NUMBER OF WATER HEATING UNITS IN THE HOME

Number of Water Heating Units	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	5	7.4%	5	7.4%
1	61	89.7%	66	97.1%
2	2	2.9%	68	100.0%

Table 10-31 below displays the frequency of sinks observed in surveyed homes. All surveyed homes had at least one sink, with 64.7% of respondents having one or two sinks. No homes surveyed had more than 6 sinks.

TABLE 10-31 NUMBER OF SINKS IN THE HOME

Number of Sinks	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	1	1.5%	1	1.5%
2	43	63.2%	44	64.7%
3	15	22.1%	59	86.8%
4	7	10.3%	66	97.1%
5	1	1.5%	67	98.5%
6	1	1.5%	68	100%

Table 10-32 below displays the frequency of low-flow faucet aerators observed in surveyed homes. Eighty-one percent (80.8%) of surveyed homes had at least one low-flow aerator meeting the EPA's low-flow specifications of 1.5 gallons per minute (GPM) for bathrooms and 2.2 GPM for kitchens.

TABLE 10-32 NUMBER OF LOW-FLOW FAUCET AERATORS IN THE HOME

Number of Aerators	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	13	19.7%	13	19.7%
1	11	16.7%	24	36.4%
2	31	47.0%	55	83.3%
3	8	12.1%	63	95.5%
4	2	3.0%	65	98.5%
5	1	1.5%	66	100%
Missing Observations = 2				

Table 10-33 below displays the frequency of showerheads observed in surveyed homes. Ninety-nine percent (98.5%) of surveyed homes had at least one showerhead. Seventy-nine percent (79.1%) of respondents with at least one showerhead had only one. No homes surveyed had more than 2 showerheads.

TABLE 10-33 NUMBER OF SHOWERHEADS IN THE HOME

Number of Showerheads	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	1.5%	1	1.5%
1	53	77.9%	54	79.4%
2	14	20.6%	68	100%

Table 10-34 below displays the frequency of low-flow showerheads observed in surveyed homes. Seventy-two percent (72.1%) of surveyed homes had at least one low-flow showerhead meeting the EPA's low-flow specifications of 2.0 GPM. Seventy-eight percent (77.8%) of all showerheads observed in surveyed homes met EPA low-flow specifications. No homes surveyed had more than 2 low-flow showerheads.

TABLE 10-34 NUMBER OF LOW-FLOW SHOWERHEADS IN THE HOME

Number of Showerheads	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	17	25.8%	17	25.8%
1	35	53.0%	50	78.8%
2	14	21.2%	66	100%
Missing Observations = 2				

Table 10-35 provides data on the presence of installed faucets, faucet aerators, and low water flow fixtures in surveyed homes compared to the 2015 baseline study. In the table below and throughout this study, the low-flow specification was defined according to the EPA's specifications for qualifying low-flow fixtures. Sixty-four percent (64.3%) of faucets observed in surveyed homes met low-flow specifications, significantly higher than the 2015 baseline of 38%. The incidence of low-flow showerheads observed in surveyed homes of 77.8% was also significantly higher than the 2015 baseline of 16%.

TABLE 10-35 LOW-FLOW FAUCETS & SHOWERHEADS

	2015 Statewide Study		2018 LIHEAP Study	
Faucets and Showerheads	N	Percentage	N	Percentage
Low-Flow Sink Faucets (1.5 GPM or Less)	51	38%	110	64.3%
Total Faucets	134	100%	171	100%
Low-Flow Showerheads (2.0 GPM or Less)	9	16%	63	77.8%
Total Showerheads	58	100%	81	100.0%
Total On-Site Surveys	**41**		**68**	

Table 10-36 below displays the saturation levels of appliances found in surveyed homes compared with appliance saturation levels measured by the 2015 baseline study. One-hundred percent (100%) of surveyed homes had at least one refrigerator, matching the percentage of statewide homes in 2015 with at least one. The percentage of surveyed homes with at least one clothes washer (89%) and at least one clothes dryer (85%), were significantly higher than the 2015 baseline of 52% and 35% respectively. The percentages of surveyed homes with at least one freezer (47%), one dishwasher (47%), and one dehumidifier (20%) were substantially below the 2015 baselines of 57%, 54%, and 28% respectively.

TABLE 10-36 APPLIANCE SATURATION

Appliance	2015 Statewide Study - % Home with at Least One	2018 LIHEAP Study - % of Homes with at Least One	2018 LIHEAP Study - Appliance Saturation (Number of Appliances Divided by the Number of Homes Surveyed)
Refrigerator	100%	100%	114%
Television	-	97%	226%
Cell Phone Charger	-	78%	181%
DVD/Blu-Ray	-	69%	94%
Clothes Washer	52%	89%	89%
Clothes Dryer	35%	85%	85%
Laptop Computer	-	55%	82%
Portable Space Heater	-	51%	80%
Gaming System	-	31%	59%
Freezer	57%	47%	55%
Tablet Device	-	35%	53%
Dishwasher	54%	49%	49%
Desktop Computer	-	33%	42%
VCR	-	31%	31%
Dehumidifier	28%	20%	28%
Stereo System	-	25%	28%
Air Purifier	-	14%	19%
Humidifier	-	16%	16%
Home Theater	-	5%	5%
Fax Machine	-	3%	3%

Table 10-37 below displays the percentage of various appliances observed in surveyed LIHEAP households that were reported as meeting compliance with ENERGY STAR specifications upon manufacturing. As shown below, the highest incidence of compliance for any appliance was no greater than 17% and none of the appliances surveyed in 2018 met 2018 ENERGY STAR criteria. Of the appliances meeting 2015 ENERGY STAR specifications accounted for in the 2015 baseline study, 0% of the corresponding appliances observed in 2018 in LIHEAP homes met ENERGY STAR at any point in time or 2018 ENERGY STAR specifications.

TABLE 10-37 OBSERVED ENERGY STAR COMPLIANCE

Appliance	Frequency Reported Meeting ENERGY STAR	Total Appliances	2015 Statewide Study - % Meeting 2015 ENERGY STAR Specifications	2018 LIHEAP Study - % Meeting ENERGY STAR *(at the time appliance was manufactured)*	2018 LIHEAP Study - % Meeting 2018 ENERGY STAR Eligibility
Refrigerator	Not available	75	28%	0%	0%
Freezer	0	36	0%	0%	0%
Dehumidifier	3	18	60%	17%	0%
Clothes Washer	0	59	46%	0%	0%
Clothes Dryer	0	56	4%	0%	0%
Dishwasher	0	31	18%	0%	0%
Air Purifier	2	12	-	17%	0%
Humidifier	1	10	-	10%	0%

11 Transportation

This section provides information on the total number of personal vehicles observed at the 68 surveyed LIHEAP homes, the number of miles each observed vehicle was driven in the past year, and the amount of money spent on alternative forms of transportation (public transit and air travel).

Table 11-1 provides information of the total number of personal vehicles observed at the 68 surveyed LIHEAP homes. Ten of the 68 surveyed homes (14.7%) had no personal vehicle. Thirty-five of the 68 homes (51.5%) had only one personal vehicle. Twenty-five percent (25.0%) of homes had 2 vehicles. No homes surveyed had more than 4 personal vehicles.

TABLE 11-1 NUMBER OF VEHICLES OBSERVED IN THE HOME

Number of Vehicles	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	10	14.7%	10	14.7%
1	35	51.5%	45	66.2%
2	17	25.0%	62	91.2%
3	5	7.4%	67	98.5%
4	1	1.5%	68	100.0%

Table 11-2 provides information on the number of miles the first personal vehicle reported was driven in the past year. The majority of vehicles (20%) were reported as being driven 10,000 miles over the past year. The reported number of miles driven ranged from 0 – 50,000 miles in the past year.

TABLE 11-2 NUMBER OF MILES FIRST REPORTED VEHICLE DRIVEN IN THE PAST YEAR

Number of Miles	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	1.8%	1	1.8%
300	1	1.8%	2	3.6%
400	1	1.8%	3	5.4%
500	1	1.8%	4	7.1%
1,000	4	7.1%	8	14.3%
1,500	2	3.6%	10	17.9%
2,000	4	7.1%	14	25.0%
2,500	1	1.8%	15	26.8%
3,500	1	1.8%	16	28.6%
4,000	2	3.6%	18	32.1%
5,000	2	3.6%	20	35.7%
6,000	4	7.1%	24	42.9%
7,000	3	5.4%	27	48.2%
7,500	1	1.8%	28	50.0%
8,000	3	5.4%	31	55.4%
10,000	11	19.6%	42	75.0%
11,000	2	3.6%	44	78.6%
12,000	4	7.1%	48	85.7%
12,500	1	1.8%	49	87.5%
14,000	1	1.8%	50	89.3%
15,000	1	1.8%	51	91.1%
20,000	3	5.4%	54	96.4%
30,000	1	1.8%	55	98.2%
50,000	1	1.8%	56	100.0%

Table 11-3 provides information of the number of miles the second reported vehicle was driven in the past year. The reported number of miles driven ranged from 100 – 30,000 miles in the past year.

TABLE 11-3 NUMBER OF MILES SECOND REPORTED VEHICLE DRIVEN IN THE PAST YEAR

Number of Miles	Frequency	Percent	Cumulative Frequency	Cumulative Percent
100	1	4.5%	1	4.5%
200	1	4.5%	2	9.1%
1,000	3	13.6%	5	22.7%
3,000	1	4.5%	6	27.3%
4,000	3	13.6%	9	40.9%
6,000	1	4.5%	10	45.5%
8,000	2	9.1%	12	54.5%
9,000	1	4.5%	13	59.1%
10,000	2	9.1%	15	68.2%
12,000	3	13.6%	18	81.8%
18,000	1	4.5%	19	86.4%
20,000	2	9.1%	21	95.5%
30,000	1	4.5%	22	100.0%

Table 11-4 provides information of the number of miles the third reported vehicle was driven in the past year. The number of miles driven ranged from 30 – 10,000 miles.

TABLE 11-4 NUMBER OF MILES THIRD REPORTED VEHICLE DRIVEN IN THE PAST YEAR

Number of Miles	Frequency	Percent	Cumulative Frequency	Cumulative Percent
30	1	16.7%	1	16.7%
1,000	1	16.7%	2	33.3%
5,000	2	33.3%	4	66.7%
6,000	1	16.7%	5	83.3%
10,000	1	16.7%	6	100.0%

Table 11-5 provides information on the number of miles the fourth reported vehicle was driven in the past year.

TABLE 11-5 NUMBER OF MILES FOURTH REPORTED VEHICLE DRIVEN IN THE PAST YEAR

Number of Miles	Frequency	Percent	Cumulative Frequency	Cumulative Percent
10,000	1	100.0%	1	100.0%

Table 11-6 provides information on the reported amount of money spent on public transit by respondents from the 68 surveyed homes. The majority of respondents (89.6%) had spent no money on public transit. No respondents had spent more than $960 on public transit.

TABLE 11-6 AMOUNT OF MONEY SPENT ON PUBLIC TRANSIT

Money Spent (USD)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	43	89.6%	43	89.6%
6	1	2.1%	44	91.7%
40	1	2.1%	45	93.8%
300	1	2.1%	46	95.8%
700	1	2.1%	47	97.9%
960	1	2.1%	48	100.0%

Table 11-7 provides information on the reported amount of money spent on personal air travel by respondents from the 68 surveyed homes. The majority of respondents (89.6%) had spent no money on personal air travel. No respondents had spent more than $1,300 on personal air travel.

TABLE 11-7 AMOUNT OF MONEY SPENT ON PERSONAL AIR TRAVEL

Money Spent (USD)	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	43	89.6%	43	89.6%
150	1	2.1%	44	91.7%
240	1	2.1%	45	93.8%
300	1	2.1%	46	95.8%
1,000	1	2.1%	47	97.9%
1,300	1	2.1%	48	100.0%

12 Findings & Recommendations

This section of the report provides findings and recommendations with respect to the best opportunities for installation or adoption of energy efficiency measures, practices and equipment in low-income households in the State of Maine. This report however, has not examined the cost effectiveness of these savings opportunities nor has it examined in detail the magnitude of the potential energy savings. Based on the data compiled for the 2018 Maine Office of the Public Advocate Low-Income Household Baseline Study, GDS has identified the following areas as having significant energy efficiency savings potential for low-income homes in Maine:

12.1 AIR SEALING UPGRADES

The 2018 Maine OPA Energy Efficiency Baseline Study has identified that ***60% of surveyed low-income Maine households had partially sealed or poorly sealed weatherization around doors and windows.*** A comprehensive approach to upgrading air sealing in lower-income households would involve caulking around all building penetration areas (e.g. doors and windows, fireplaces and chimneys, cooling and plumbing lines, and electrical fixtures) and installation of electrical receptacle gaskets to minimize heat loss. This finding is consistent with Oak Ridge National Laboratory evaluations of state-administered weatherization programs for low-income housing. [48]

12.2 DUCT SEALING UPGRADES

Many of the surveyed homes with HVAC ductwork in unconditioned space need insulation added to this ductwork. In addition, GDS surveyors found poorly sealed HVAC ductwork in many homes. Estimated losses from inefficient ductwork account for approximately 10% to 30% of total residential energy losses. Current recommendations specify the majority of existing ductwork should be installed in conditioned space whenever possible to minimize energy losses due to ductwork. There is significant energy savings potential remaining in Maine's low-income homes for duct insulation and duct sealing measures.

12.3 ADDITIONAL WALL INSULATION

Current insulation code guidelines for the State of Maine specify a minimum R-value of R-20 for walls.[49] The Maine OPA 2018 baseline study data indicates that low-income homes with existing wall insulation had an average R-value of R-10, well below the current guidelines. Thirty-six of the 68 surveyed homes had wall R-values below R-10. There is significant energy efficiency potential remaining to be captured in low-income homes in Maine by increasing attic and wall insulation levels in existing low-income homes to the recommended levels for Maine.

12.4 ADDITIONAL ATTIC INSULATION

The average attic insulation R-value in the surveyed homes is R-30, slightly higher than the 2015 statewide baseline study. There is energy savings potential in the segment of the low-income market that has insufficient amounts of attic insulation. The International Energy Conservation Code Insulation guideline for Maine for attic insulation for energy efficient residential construction is R-49. Only 9% of surveyed LIHEAP homes reported an attic insulation R-value of R-49 or higher. ***Twenty-five percent of surveyed low-income homes had an R-value for attic insulation of R-20 or lower.*** There are also significant energy savings opportunities remaining relating to adding floor insulation and insulation for foundation walls.

12.5 SPACE HEATING SYSTEM UPGRADES

2018 survey data indicates that the ***observed average energy efficiency rating*** of furnaces and boilers ***in low-income homes is lower than the 2015 baseline space heating system efficiency of 81%*** in all single-family homes

[48] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, "Q&A: The Weatherization Assistance Program", OCTOBER 29, 2013

[49] IECC Compliance Guide for Homes in Maine

in Maine. The 2018 data additionally finds that 37% of low-income homes with space heating equipment older than one year have not had their space heating equipment serviced in over a year. GDS recommends that the design of future energy efficiency programs for low-income households in Maine consider the opportunities for significant energy savings from the following energy efficiency measures relating to HVAC equipment:

- For energy efficiency programs for low-income households, consider including a component to cover some or all of the cost of yearly inspection and servicing of space heating equipment. GDS notes that 37% of surveyed low-income households with space heating equipment older than one year do not have their space heating equipment serviced annually. It is important to have space heating equipment serviced annually to ensure that the equipment will continue to operate efficiently and to ensure that the equipment will not fail during the long winter heating season in Maine.
- Consider including a component to replace inefficient space heating equipment. A major issue of concern is that the average age of 29.7 years for central heating systems in Maine low-income homes is significantly higher than the 19-year average age of central heating systems in all single-family homes in Maine. Older space heating equipment is much less energy efficient than new models of equipment available in 2018. The 51 oil and kerosene-fired boilers and furnaces in the surveyed low-income homes have an average age of approximately 16.7 years and an average energy efficiency level below 80% AFUE. The current federal standard for residential hot water boilers is a minimum efficiency of 84% AFUE for oil-fired equipment and 83% AFUE for residential non-weatherized oil-fired furnaces. A program planner could use this information to determine the remaining potential for energy and dollar savings that could be obtained by upgrading older, inefficient oil-fired residential furnaces and boilers in low -income homes in Maine. This type of information can also be useful for determining the cost effectiveness of such equipment upgrades.
- The information collected in this baseline study on the quality of HVAC duct sealing indicates that 60% of the ductwork in low-income homes is partially or poorly sealed. GDS surveyors also found that (1) 67% of HVAC ductwork outside of conditioned space was not insulated and (2) 43% of low-income homes have manual thermostats. This information provides support for including a program component targeted at (1) proper sealing and insulation of HVAC ductwork in low-income homes in Maine and (2) replacement of manual thermostats with programmable thermostats.

12.6 WATER HEATING SYSTEM UPGRADES & ENERGY EFFICIENCY MEASURES

This 2018 baseline study determined that 60 percent of the surveyed homes use electricity as the primary fuel for water heating. Most of these electric water heaters are stand-alone water heaters with a large tank for storing hot water. The detailed information provided in this report about the primary fuels and type of equipment used by low-income homes in Maine for water heating is useful for identifying where opportunities exist for additional energy savings with the water heating end use.

The data collected by GDS surveyors indicates that 48.4% percent of all water heating units in low-income homes were stand-alone "tank-type" water heaters fueled by electricity, yielding an average of 0.456 water heating units per household. The Efficiency Maine web site provides information on the annual kWh use of a standard electric tank-type water heater (3,387 kWh) versus a heat pump water heater (960 kWh).[50] According to the Maine Department of Health and Human Services, there are 175,924 low-income households in Maine. Based on the percent of low-income homes with electric tank-type water heaters and the 175,924 low-income households in Maine, that there are 80,221 electric "tank-type" water heaters in low-income homes in Maine. If all of these electric "tank-type" water heaters were converted to heat pump water heaters, energy savings of 2,427 kWh for each electric water heater replaced could be achieved. A heat pump water heater can save a family of four in Maine approximately $360 a year on the household's electric bill. Total annual savings for all of these replacements would total 194,696,367 kWh annually. Similar calculations of potential annual kWh savings can be done for other water heating energy efficiency measures.

[50] https://www.efficiencymaine.com/at-home/home-energy-savings-program/water-heating-cost-comparison/

Other water heating efficiency measures that have significant energy saving potential in Maine's low-income homes include the following:

- Insulation of hot water pipes
- Faucet aerators for kitchen and bathroom sinks
- Low-flow showerheads
- Water heater insulation blankets
- Water temperature setback to 120 degrees Fahrenheit for equipment where the water heater temperature is set too high
- High efficiency water heater
- Solar water heating system

12.7 REPLACEMENT OF INCANDESCENT BULBS WITH LED BULBS

The 2018 Maine OPA survey data shows that ***38% of interior sockets and 35% of all exterior sockets in low-income homes contain incandescent and three-way incandescent bulbs. Only 24% of interior sockets and 22% of exterior sockets contain LED bulbs***, indicating an opportunity to install a greater number of LED bulbs for interior and exterior lighting in low-income households. GDS notes that the amount of energy savings from installing LED bulbs will decrease significantly when the new EISA energy efficiency baseline provisions for residential lighting become effective on January 1, 2020.

GDS surveyors collected detailed information on every light bulb socket and light bulb in the interior and exterior of the 68 surveyed homes. For each socket GDS collected the room type (living room, dining room, kitchen, bedroom, etc.) where the socket is located, type of socket (medium Edison base, pin base, candelabra, night light, other), bulb type, bulb wattage and presence of a lighting control. If all incandescent bulbs in the interior of low-income homes were replaced with LED bulbs, the annual kWh savings per bulb would be at least 49 kWh annually, and total savings from replacing all interior incandescent bulbs would be at least 87 million kWh annually.[51] GDS surveyors also found that 0% of interior bulbs are controlled with occupancy sensors. Additional energy savings potential could be achieved if 100% of interior bulbs in high-use areas of the home were controlled with occupancy sensors.

GDS recommends that the Maine OPA and the Efficiency Maine Trust use the annual hours of use and peak load coincidence factors from the Maine OPA low income household light logger study when calculating the kWh and kW savings of low income lighting energy efficiency programs in Maine.

12.8 REPLACEMENT OF INEFFICIENT CONSUMER APPLIANCES

GDS surveyors found that 36 of the 68 homes (52.9%) had at least one room air conditioner (RAC). The total number of room air conditioners counted in the 36 homes was 57. The average energy efficiency of these 57 units was 10.3 EER. The minimum and maximum EER ratings for the 57 units are 8 and 12.1 EER. The average age of these 57 units is 8 years. The 2018 minimum required EER by the U.S. EPA Energy Star program is 12 EER for units with a rated output capacity below 14,000 BTU/hour.[52] If all room air conditioner units in low-income homes in Maine were replaced with units that meet 2018 Energy Star product criteria, low-income consumers could save $40 a year over the ten-year life of each room air conditioner replaced.[53] The potential annual savings to low-income consumers would be $5.9 million a year (175,924 low-income homes X 52.9% of homes with RAC X 1.58 RAC per home X $40 per home per year).

[51] This calculation is based on a 60-watt incandescent bulb being replaced with a 15-watt LED bulb; 38 percent of light bulbs in the interior of low-income homes are incandescent bulbs, and the average hours of use per day for a residential light bulb in a low-income home in Maine is 3 hours.

[52] https://www.energystar.gov/products/heating_cooling/air_conditioning_room/key_product_criteria

[53] See the Efficiency Maine website at https://www.efficiencymaine.com/docs/Room-Air-Conditioner-Rebate.pdf.

Second, GDS finds that significant energy efficiency savings potential exists in low-income homes by replacing other existing, inefficient electric appliances with appliances that meet 2018 ENERGY STAR requirements. None of the major appliances (refrigerators, freezers, dishwashers, etc.) in the surveyed low-income homes in Maine meet 2018 ENERGY STAR requirements. This report has not examined the cost effectiveness of the energy savings potential relating to replacing inefficient electric appliances in low-income homes in Maine nor has it examined the magnitude of the potential electricity savings due to such appliance retrofits for refrigerators, freezers and dishwashers.

12.9 WATER CONSERVATION MEASURES

The 2018 Low-Income Baseline Study found that 78% of showerheads meet EPA gallons per minute (GPM) low-flow criteria, significantly better than the percentage found in the 2015 Statewide baseline study of 16%. On the other hand, 22% of showerheads are not low-flow showerheads and could be upgraded to low-flow status.

The 2015 baseline study additionally reported that despite the overall high rate of incidence of aerators in Maine single-family homes, only 38% of all faucets had aerators meet the EPA's low-flow specification of 1.5 GPM for bathrooms and 2.2 GPM for kitchens, much lower than the observed incidence of low-flow aerators in 64% of low-income homes surveyed. While low-income homes fare better than the 2015 baseline, improvements to faucets in the remaining 36% of low-income households could be considered as part of any future energy or water efficiency program for low-income homes in Maine.

12.10 HIGH EFFICIENCY WINDOWS

Many low-income homes (25%) still have inefficient, single-pane windows. Only 1% of the 68 low-income homes surveyed have triple-pane windows. Replacement of single-pane windows in low-income homes could provide significant energy savings.

APPENDIX A *Survey Instrument for 2018 Maine Low-Income Household Energy Efficiency Baseline On-Site Surveys*

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- Email address		
PI.7- 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)	☐ Central Maine Power Company ☐ Emera (formerly Bangor Hydro) ☐ Eastern Maine Electric Cooperative ☐ Maine Public Service ☐ Other: _____ ☐ Don't know

Inspection ID # _____

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)?	_____

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?			

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	

Inspection ID # _____

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					
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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	

Inspection ID # _____

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	

Inspection ID # _____

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	

Inspection ID # _____

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**

Inspection ID # _____

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**

Inspection ID # _____

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_____ ☐

Inspection ID # _____

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** ☐

	Clothes Washer Manufacturer	**Clothes Washed 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) ☐

	Clothes Dryer Manufacturer	**Clothes Dryer Model #**	**Est. Age** (# of Years)	**ENERGY STAR?** (1-Yes 2-No/DK)	**Estimated # of Loads per Week**	**Fuel Type:** **1- Nat Gas** **2- Electric** **3- Propane** 4- **Other**
	(a)	(b)	(c)	(d)	(e)	(f)
CW.2						
CW.3						

Inspection ID # _____

CD.4 Are there any shared clothes dryer units on-onsite? Yes ☐ No ☐

CD.5 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 ☐ 2. Sometimes ☐ 3. Frequently ☐	1. Never/Rarely ☐ 2. Sometimes ☐ 3. Frequently ☐	1. Never/Rarely ☐ 2. Sometimes ☐ 3. Frequently ☐	1. Never/Rarely ☐ 2. Sometimes ☐ 3. Frequently ☐

Inspection ID # _____

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 4 – LED 2- Plasma 5 – Projection 3- LCD 6 - Other	Plug-In Peripherals (#)	Power Strip Present? 1-No Strip 3. Smart Strip 2-Basic Power 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				

Inspection ID # _____

*** 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 ☐

Inspection ID # _____

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 System Heating Capacity (Btuh)	(g)			
Programmable Thermostat	(h)	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 by each fuel (estimate)	(i)			

*** 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

Inspection ID # _____

HT.10 – How many fireplaces in the home are used for space heating (if any)?	

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 ☐

Inspection ID # _____

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 ☐

Inspection ID # _____

PSH.7	1. Electric □ 2. Non-Electric □			1. Yes □ 2. No □

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- Solar
2- Electric	7- Solar	2- Tankless (On Demand)	7 - Other
3- Propane	**8- Wood**	3- Indirect Fired	888 – Don't know
4- **Kerosene**	**9 - Other**	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?		

Inspection ID # _____

(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?		

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 ☐ 999. Not app ☐	1. Yes ☐ 2. No ☐ 888. DK ☐ 999. Not app ☐
Insulation Type (see Table below)	(b)				
Avg. Insulation Thickness (Observable) *Inches* (888-DK)	(c)				
Avg. Insulation R-Value (888-DK)	(d)				
TESTO U Value Measurement	(e)	**Not applicable**		**Not applicable**	**Not applicable**

INSULATION CODE TABLE (WITH R-VALUE **PER INCH** BY TYPE OF INSULATION)

Insulation Type		
1 – Fiberglass Batt (3.3 R)	5 – Dense Pack Cellulose (3.8 R)	8 – Vermiculate (?)
2 – Fiberglass Loose Fill (2.5 R)	6 – Rigid Board (?)	9 – Other _____
3 – Cellulose Loose Fill (3.3 R)	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)				

Inspection ID # _____

# that are double paned	(c)				
# that are triple paned	(d)				
Average age (years)	(e)				
# with storm windows	(f)				
Sash material (vinyl, wood, metal, etc.)	(g)				
Average condition of windows	(h)	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	(i)	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	(j)	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	(k)	_____ *sq ft.*	_____ *sq ft.*	_____ *sq ft.*	_____ *sq ft.*

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.1A	Is duct work present in the home?	1. Yes 2. No 888. Don't Know
DS1.B	**Is duct work in conditioned space?**	**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 (check one)	1. R-8 or greater ☐ 2. R-4 – R-7 ☐ 3. Less than R-4 ☐ 4. Not insulated ☐ 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 ☐

ADDITIONAL COMMENTS ON MISCELLANEOUS COMMENTS

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 home in 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 ☐

Inspection ID # _____

Transportation Items:

TRAN.1	How many vehicles are owned or leased by this household?	Number of vehicles: _____
TRAN.2	**What is the make and model of the first vehicle owned by this household, and number of miles driven in the past year for this vehicle?**	Make:_____ Model:_____ Mileage past 12 months: _____miles
TRAN.3	**What is the make and model of the second vehicle owned by this household, and number of miles driven in the past year for this vehicle?**	Make:_____ Model:_____ Mileage past 12 months: _____miles
TRAN.4	**What is the make and model of the third vehicle owned by this household, and number of miles driven in the past year for this vehicle?**	Make:_____ Model:_____ Mileage past 12 months: _____miles
TRAN.5	**What is the make and model of the fourth vehicle owned by this household, and number of miles driven in the past year for this vehicle?**	Make:_____ Model:_____ Mileage past 12 months: _____miles
TRAN.6	**What is your best estimate of the amount your household spends per year on public transportation for land travel (buses, trains, etc.)?**	$_____
TRAN.7	**What is your best estimate of the amount your household spends per year on transportation for personal air travel that is not business related?**	$_____

Inspection ID # _____

APPENDIX B *Initial Recruitment Letter Distributed to Maine Households in Sample*

State of Maine
Office of the Public Advocate
112 State House Station, Augusta, Maine 04333-0112
(207) 624-3687 (voice) 711 (TTY) www.Maine.gov/meopa

Paul R. LePage
GOVERNOR

Barry J. Hobbins
PUBLIC ADVOCATE

January 17, 2018

<Name>
<Address One>
<Address Two>
<City, State, Zip>

Dear <salutation> <Last Name>,

We are looking for volunteers to help us gather information on energy-consuming equipment in Maine homes, including lights, heating and cooling systems and electric appliances. The Maine Office of the Public Advocate (OPA) has contracted with GDS Associates (GDS) to help gather this information. The research will assist us in finding ways to help Maine households save energy and money. The OPA is a state agency charged with representing the interests of Maine residential utility customers and helping to keep their rates as low as possible. Our Office is also working with the Efficiency Maine Trust to help Maine households save energy and reduce their electric bills.

Volunteers who qualify to participate in this study will receive a $50 Visa gift card after the on-site survey is completed by GDS.

To volunteer for the study, please visit https://www.gdsassociates.com/opa-housing-study and complete a short survey. You will be asked to enter your unique ID number, which is: **<ID CODE>.** You may also contact GDS toll-free at 1-800-8142616, extensions 1118 or 1156, and reference the "Maine OPA Residential Energy Study." If we are away from the phone when you call, please leave a voicemail message with your name and a telephone number and we will get back in touch with you.

Everyone who completes the online survey or contacts GDS by telephone will be entered into a drawing for one of three additional $100 Visa gift cards.

As a potential participant in this study, you may receive a call from a GDS representative asking your permission to conduct an on-site visit for this study and to monitor the lighting in your household. If you agree to participate, a trained employee of GDS will visit your home to gather information about the energy-consuming equipment in the home, install metering equipment on 7 to 8 light bulbs in your home, and measure existing levels of ceiling and wall insulation.

All data collected for this study will be kept anonymous. The information will help the Maine OPA and the Efficiency Maine Trust to develop better residential energy efficiency programs. Your participation in this survey would be appreciated, but is entirely optional. If you have any questions or concerns, please feel free to contact the Maine Office of the Public Advocate at 207-624-3687 or through email (OPA@maine.gov). Please be sure to reference the "Maine OPA Residential Energy Study".

Thank you.

Barry Hobbins,
Public Advocate

APPENDIX C *Copy of Recruiting Postcard Distributed to Maine Households in Sample*

State of Maine
Office of the Public Advocate
112 State House Station
Augusta, ME 04333-0112
207-624-3687

February 23, 2018

We are looking for more households to participate in our study of energy-consuming equipment in Maine homes, including lights, heating and cooling systems and electric appliances. To volunteer for the study, call GDS (our subcontractor) toll-free at 1-800-814-2616, extension 8383, and reference the "Maine OPA Residential Energy Study" and your ID number 0000707515. If we are away from the phone when you call, please leave a voicemail message with your name and a telephone number and we will get back in touch with you. You can also volunteer for the study at this web site: https://www.gdsassociates.com/opa-housing-study.

Everyone who completes the online survey or contacts GDS by telephone will be entered into a drawing for one of three additional $100 Visa gift cards.

Thank you.

APPENDIX D *Recruiting Script for Incoming Phone & Internet Inquiries*

2018 Maine Residential Low-Income Baseline Study
Recruiting Script for Incoming Phone Calls for Maine Households
(REV A – January 24, 2018)

This script should be used by GDS consultants taking incoming phone calls from Maine households interested in participating in the Maine Energy Efficiency Baseline Study.

Recruiter Information (do not read this section out loud to callers):

Note: All information for the random sample of Maine low income residential customers eligible to be recruited is maintained in an Excel database. This information should be treated as confidential and includes 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 GDS consultant doing the recruiting for each LIHEAP customer.

Greeting to Use When a Call Comes In:

Hello, my name is _____ from GDS Associates. Are you calling to apply to participate in the Maine Energy Efficiency Baseline study? (If "yes", continue the interview. If "no", thank the caller.)

Did you receive a letter recently in the mail from the Maine Office of the Public Advocate PA notifying of the opportunity to participate in an energy efficiency study of Maine households? (If "yes", continue the interview.)

Did you have a chance to read the letter?

> **If No:** The letter was to inform you that the Maine Office of the Public Advocate is working closely with the Efficiency Maine Trust to collect information on the lighting, appliances, and other energy using equipment installed in your home. We are inviting randomly selected Maine homeowners to participate in this study. This study involves a trained surveyor visiting your home to collect information on the electric energy using equipment in your home as well as insulation levels. The Maine OPA is conducting this research to find ways to help Maine consumers save energy and money. Each eligible participating homeowner will receive a Visa Reward Card for $50 once the site visit is completed.
>
> **If Yes:** Great! As noted in the letter, the Maine Office of the Public Advocate and GDS Associates, the firm hired by the Office of the Public Advocate 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.

Can I ask you a few questions to see if you're eligible to participate in this study?

> **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 is your unique ID # (number) from the letter from the Maine Office of the Public Advocate?

Unique ID:_____

Q2: What is your name? _____

Q3. What is your street address, city and zip code?

Sreet:_____

City, State, Zip Code_____

Q4: What is your phone number? _____

Q5: 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: _____
f.

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? [1]

a. Own
b. Rent

Q4: What is your age?

ENTER AGE: _____

[1] GDS will only include questions Q3 and Q4 if these are needed for sample stratification purposes.

Q5: What fuel do you use to primarily heat your home? (circle one)?

a. Electricity
b. Natural Gas
c. Propane
d. Oil (#2 fuel oil)
e. Kerosene
f. Wood
g. Solar
h. Coal
i. Other
j. Don't know

INTERVIEWER: *Review quotas sheets to determine if quota bin is full.*

(IF QUOTA BIN IS NOT FULL), SKIP TO NEXT PAGE

(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 your area 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 Quota bin is full: Thank you for calling us. Should we receive any cancellations over the next four weeks as we conduct surveys in your area, would you like to be added to our list of households to contact in the event that a space opens up for an on-site visit?

If Quota bin is full: Last, 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 gds surveyor to your home with a picture ID. GDS will let you know ahead of time the name of the surveyor who would be coming 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. This survey is designed to count and collect data on all your energy-using equipment. The surveyor would count the number of lighting sockets in your home and collect the make and model information of electric appliances and other energy using equipment. We will also deploy metering equipment (loggers) on 7-8 light bulbs in your home 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 approximately six months, require no maintenance, and again, record no other information than how long a light is turned on or off each day.

This study will be used to identify electric and other fuel energy savings opportunities in homes throughout Maine. Upon completion of the on-site survey of your home, each participating Maine homeowner will receive a Visa Rewards Card for $50 for participating.

We expect these on-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. Our final report will only release summaries of the data collected. All individual household data, names and addresses 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. Once an appointment is scheduled, proceed to INVITE.

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>***

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 Kaytie Ruditys, a Project Consultant at GDS Associates, at 1-770-799-2406 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, and the name of the trained GDS surveyor. 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.

APPENDIX E *Outgoing Phone Recruiting Script*

2018 Maine Residential Low-Income Baseline Study
Recruiting Script (REV B – DRAFT FOR COMMENT)

Recruiter Information:

Note: All information for the random sample of Maine LIHEAP 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 GDS consultant doing the recruiting for each LIHEAP 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 or disconnected*
8. *Other (please specify: _____)*

In the event that the phone was busy or there was no answer, GDS 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 Maine 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 GDS Associates, calling on behalf of the Maine Office of the Public Advocate. The Maine OPA is conducting research to find ways to help consumers save energy in their homes in Maine.

You may have received a brief letter in the mail from the Maine OPA 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 $50 for your time, once the on-site survey is completed. 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 GDS at 1-800-293-1538 x106.

If you have any questions or concerns about this call, please call the Maine Office of the Public Advocate at 207-624-3687 and reference "Maine Energy Usage Survey"

Thank you, and have a good day/night.

Recruitment Script

Hello, my name is _____ from GDS Associates and I am calling on behalf of the Maine Office of the Pubic Advocate. Is <CONTACT NAME>, available?

When correct contact is located:

I am calling on behalf of the Maine Office of the Public Advocate to inform you of an opportunity to participate in a survey of Maine consumers about energy usage and equipment. I am not selling anything. You may have received a brief letter in the mail from the Maine Office of the Public Advocate 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 the Maine Office of the Public Advocate is working closely with the Efficiency Maine Trust to collect information on the lighting, appliances, and other energy using equipment installed in your home. We are inviting randomly selected Maine homeowners to participate in this study. This study involves a trained surveyor visiting your home to collect information on the electric energy using equipment in your home as well as insulation levels. The Maine OPA is conducting this research to find ways to help Maine consumers save energy and money. Each eligible participating homeowner will receive a Visa Reward Card for $50 once the site visit is completed.
>
> **If Yes:** Great! As noted in the letter, the Maine Office of the Public Advocate and GDS Associates, the firm hired by the Office of the Public Advocate 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.

Can I ask you a few questions to see if you're eligible to participate in this study?

> **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? [1]

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. Propane
d. Oil (#2 fuel oil)
e. Kerosene
f. Wood
g. Solar
h. Coal
i. Other
j. 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 your area 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>**

[1] GDS will only include questions Q3 and Q4 if these are needed for sample stratification purposes.

(IF RESPONDENT QUALIFIES): To participate in this research, we would like to send a trained surveyor to your home with a picture ID. GDS will let you know ahead of time the name of the surveyor who would be coming 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. This survey is designed to count and collect data on all your energy-using equipment. The surveyor would count the number of lighting sockets in your home and collect the make and model information off electric appliances and other energy using equipment. We will also 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 approximately six months, require no maintenance, and again, record no other information than how long a light is turned on or off each day.

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If No: That's ok, I understand. Thank you very much for your time. Have a good day/night. **<END CALL>**

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INTERVIEWER: If respondent is not available for any open appointments, read:

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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>***

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 Jeffrey Huber, a Senior Project Manager at GDS Associates, at 1-770-799-2399 and he 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, and the name of the trained GDS surveyor. 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.

APPENDIX F *Memo to Maine OPA Regarding Sample for On-Site Surveys*

MEMO

To: Agnes Gormley, Maine Office of the Public Advocate
From: Dick Spellman and Jeffrey Huber, GDS Associates
RE: Sample Selection Concerns for the Maine Low-Income Baseline Study
Date: 12/01/17 *(Updated 12/13/17)*

UPDATE

GDS Associates hosted a brief teleconference on December 12, 2017 with members of the Maine Office of the Public Advocate (OPA), Efficiency Maine Trust, and Synapse Energy Economics to discuss the sample selection concerns associated with the Maine Low-Income Baseline Study. The initial concerns and resolutions discussed during the teleconference are included below:

Q1 Did GDS accurately adjust the 2017 LIHEAP dataset to remove LI-qualified homes that do not pay for their heat and/or electricity?

A ***GDS did accurately remove LI-qualified homes that do not pay for their heat and/or electricity according to the definitions included in the LIHEAP database.***

Q2 For purposes of conducting the LI Baseline Study, should the LIHEAP dataset (after removing homes that do not pay for heat and/or electricity) be viewed as the appropriate "population" of LI-qualified households from which to pull the recruitment sample?

A ***It is appropriate to view the Maine LIHEAP database as the "population" of LI-qualified households in Maine. All parties reached consensus that the sample should represent low-income homes that are eligible to participate in Efficiency Maine low-income programs. Efficiency Maine Trust low-income programs are limited to "means tested" participants. Since Efficiency Maine does not directly verify income status, LIHEAP eligibility adequately addresses this requirement. As such, all Maine LIHEAP participants are eligible to participate in the Efficiency Maine Trust low-income programs. Maine LIHEAP income eligibility is consistent with 150% below the federal poverty level.***

Item for Additional Future Discussion

The Efficiency Maine Trust requested that GDS seek permission from on-site survey participants to release billing history detail for additional remote audit analyses. GDS expects to gain similar permission from homeowners. GDS noted that it may be possible to gain permission from a larger sample than the on-site participants during the recruitment phase. Efficiency Maine will consider whether a larger sample, without corresponding household equipment characteristics, would be beneficial to their future analysis.

Next Steps

GDS will develop the recruitment sample from the LIHEAP database (after removing accounts that do not pay for heating and/or electricity). The recruitment sample is expected to include approximately 1,200 randomly selected records. GDS will also provide draft recruitment letters and recruitment screeners to members of the OPA, Efficiency Maine Trust, and Synapse Energy Economics for review and comment.

The original memo is provided below for additional context:

****

Overview

On September 18, 2017 GDS Associates participated in the Maine Low Income Baseline Study kick-off meeting with staff of the Maine Office of the Public Advocate (OPA), Efficiency Maine Trust, and Synapse Energy Economics. During this kick-off meeting, initial Maine low-income (LI) population characteristics were

presented based on statistics from the latest US Bureau of the Census American Community Survey[1] for Maine, and implications on sample selection were discussed. Two major concerns regarding appropriate sample selection were discussed at this meeting:

1. Meeting attendees were uncertain that utility datasets that identify low-income qualified customers were either available or could be provided to GDS Associates. In lieu of requesting utility data, it was suggested that GDS Associates should utilize the Maine LIHEAP database to select a recruitment sample. The 2017 LIHEAP database[2] has over 38,300 records. GDS will select a stratified random sample from the LIHEAP database of approximately 1,000-1,200 records, from which 70 on-site participants will be recruited.

2. Meeting attendees also voiced concern regarding the participation of low-income qualified residences that do not pay for their own heat or electricity. For these residences, the low-income qualified individuals living in the home would be unlikely to receive any major benefit from improved energy efficiency. Consequently, it was recommended that low-income qualified houses that do not pay for their heating and/or electricity be removed from the analysis.

   To accommodate this request, GDS created a cross-tab in the American Community Survey (ACS) Public Use Microdata Set (PUMS) to identify low-income qualified households in Maine that do not pay for their heating and/or electricity. Within the ACS PUMS dataset, LI qualified housing was identified based on survey responses to household income and number of individuals per household. ACS PUMS records were excluded if the electricity (ELEP), fuel (FULP), or gas (GASP) variables were identified as included in rent, not charged, or not used.

   Similarly, in the LIHEAP dataset, GDS removed records that were identified as (a) not having an electricity account and (b) home ownership status was recognized as "rent with heat" or "subsidized with heat."

Comparison of LI-Qualified Housing Characteristics from US Census and LIHEAP datasets

The following tables show the initial US Census and LIHEAP dataset characteristics by region, housing type, and home fuel type both before and after removing from the datasets households that do not pay for their heating and/or electricity.

Table 1: Distribution of Maine Low Income Households by County

	Pre-Adjustment		Post-Adjustment	
County	US Census	LIHEAP	US Census	LIHEAP
Androscoggin	8.7%	8.0%	n/a	6.5%
Aroostook	7.6%	10.9%	n/a	11.2%
Cumberland	17.2%	10.7%	n/a	7.5%
Franklin	2.3%	4.2%	n/a	5.0%
Hancock	4.8%	3.5%	n/a	4.1%
Kennebec	9.4%	10.1%	n/a	8.9%
Knox	2.7%	2.5%	n/a	2.9%

[1] American Community Survey 5-Year statistics are available by state. GDS developed estimates of the LI-qualified population in Maine by county using the reported data. In addition, a subset of the complete ACS dataset, the Public Use Microdata Set (PUMS) is also available. GDS developed additional crosstabs of LI-qualified housing in Maine by housing type and fuel type using the ACS PUMS dataset.

[2] June 16, 2017 LIHEAP database

	Pre-Adjustment		Post-Adjustment	
County	US Census	LIHEAP	US Census	LIHEAP
Lincoln	2.6%	2.1%	n/a	2.5%
Oxford	4.7%	5.9%	n/a	6.8%
Penobscot	12.9%	15.2%	n/a	14.2%
Piscataquis	1.7%	2.5%	n/a	3.1%
Sagadahoc	2.4%	1.6%	n/a	1.6%
Somerset	4.9%	7.0%	n/a	8.0%
Waldo	3.5%	4.4%	n/a	5.3%
Washington	3.4%	4.4%	n/a	5.4%
York	11.3%	6.9%	n/a	7.2%

Table 1 shows the distribution of Maine LI households, as characterized by the US Census American Community Survey[3] and LIHEAP database, by county. In general, the LIHEAP database shows a shift towards a higher frequency of LI households in more central (e.g. Franklin, Oxford, Waldo) and northern (e.g. Aroostook, Penobscot, Somerset) Maine counties and a lower percentage of LI-qualified households in southern counties e.g. Cumberland and York). This trend is further emphasized after GDS adjustments for removing households that do not pay for their own heat and/or electricity.

Table 2: Distribution of Low Income Households by Region

	Pre-Adjustment		Post-Adjustment	
Region	US Census	LIHEAP	US Census	LIHEAP
North	35.3%	43.7%	n/a	45.9%
Central	25.1%	29.2%	n/a	31.4%
South	39.6%	27.2%	n/a	22.7%

Table 2 collapses the county breakout shown in Table 1 into three regions in Maine (North, Central, and South). According to the US Census, the Southern counties of Maine have the largest share of the LI population (~40% of the state's LI population). Conversely, according to the LIHEAP database, the Southern region of Maine houses the lowest percentage (~23%) of LI households. After removing from the LIHEAP database homes that do not pay for heat/electricity, the Northern counties in Maine have twice as many LI households than the Southern counties.

Table 3: Distribution of Low Income Households by Housing Type

	Pre-Adjustment		Post-Adjustment	
Home Type	US Census	LIHEAP	US Census	LIHEAP
Single Family	44.3%	41.9%	71.5%	56.1%
MF (2-4 Units)	19.3%	34.7%	4.9%	12.7%
MF (5+ Units)	22.3%		0.7%	
Mobile Home/Other	14.1%	23.5%	22.9%	31.3%

Table 3 shows key differences between the US Census and LIHEAP databases in the distribution of LI households by Housing Type. Before removing households that do not pay for heat/electricity, the LIHEAP dataset contains

[3] The ACS PUMS dataset does not include a variable for region/county. As a result, GDS was not able to develop statistics for LI-qualified housing by county/region, after removing households that do not pay for heat or electricity, using the US Census ACS dataset.

a greater number of LI-qualified mobile homes and fewer LI-qualified apartments than the US Census Public Use Microdata Set (PUMS). After removing homes that do not pay for heat/electricity, both the US Census and LIHEAP datasets saw the percentage of LI-qualified single-family homes and mobile homes increase, while LI-qualified apartments decreased. This result was expected, as many of the removed homes were likely rental apartments. However, the adjusted US Census ACS PUMS dataset resulted in a substantially higher percentage of single-family households relative to the adjusted LIHEAP dataset.

Table 4: Distribution of Low Income Households by Heating Fuel Type

	Pre-Adjustment		Post-Adjustment	
Heat Fuel	**US Census**	**LIHEAP**	**US Census**	**LIHEAP**
Electricity	10.1%	8.7%	1.9%	9.7%
Oil	61.9%	42.5%	76.0%	40.5%
Natural Gas	8.1%	9.7%	0.9%	1.4%
Tank Gas	7.6%	34.7%	3.5%	42.8%
Wood	10.3%	4.4%	16.2%	5.5%
Other	2.0%	0.1%	1.5%	0.1%

Last, Table 4 shows the distribution of LI-qualified households by primary heating fuel type across the datasets. Prior to removing homes that do not pay for heat/electricity, approximately 10% of households primarily heat with electricity across the datasets while substantially more households heat with tank gas (kerosene, propane) and less oil in the LIHEAP dataset compared to the US Census ACS PUMS dataset. However, after removing homes that do not pay for their own heat/electricity, only 2% of homes are estimated to heat primarily with electric according to the US Census ACS Survey. The LIHEAP dataset remains consistent across primary heating fuel both before and after adjustment for homeowners that do not pay for their own heat/electricity.

Key Questions

Based on the brief comparison of LI-qualified housing characteristics identified in the US Census ACS Survey and the 2017 Maine LIHEAP datasets, there are two key issues where GDS would like to reach consensus with the Maine OPA and other key parties:

1. Did GDS accurately adjust the 2017 LIHEAP dataset to remove LI-qualified homes that do not pay for their heat and/or electricity?
2. For purposes of conducting the LI Baseline Study, should the LIHEAP dataset (after removing homes that do not pay for heat and/or electricity) be viewed as the appropriate "population" of LI-qualified households from which to pull the recruitment sample?
3. Or, does the recruitment sample selected from the LIHEAP dataset need to be stratified and weighted so that the distribution of LI-qualified homes by region, home type, and fuel type are more representative of the US Census ACS characteristics (i.e. end up with more SF homes, and fewer electrically heated homes, than a random sample from the LIHEAP dataset would achieve)?

GDS requests a short teleconference with Maine OPA staff, Efficiency Maine Trust staff and Synapse staff to discuss these questions to determine whether any further adjustment to the LIHEAP dataset are necessary before selecting the recruitment sample of qualified Maine LI households. This teleconference should be held as soon as practicable, based on availability.

THE MAINE OFFICE OF THE PUBLIC ADVOCATE

Maine Low-Income Household Energy Efficiency Baseline Study

prepared by

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ENGINEERS & CONSULTANTS
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