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National Weatherization Assistance Program Evaluation: Eligible Population Report

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September 2014

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

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Environmental Sciences Division

NATIONAL WEATHERIZATION ASSISTANCE PROGRAM EVALUATION ELIGIBLE POPULATION REPORT

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ACRONYMS AND ABBREVIATIONS

AC	Air Conditioning
ACS	American Community Survey
AHS	American Housing Survey
ARRA	American Recovery and Reinvestment Act
ASEC	Annual Social and Economic Supplement
Btu	British Thermal Unit
CCF	100 cubic feet
CDC	Centers for Disease Control
CDD	Cooling Degree Days
CFM50	Cubic Feet per Minute @ 50 Pascals
CFR	Code of Federal Regulations
CPS	Current Population Survey
CY	Calendar Year
DOE	Department of Energy
ECM	Energy Conservation Measure
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FY	Fiscal Year
HDD	Heating Degree Days
HUD	Department of Housing and Urban Development
kWh	Kilowatt Hour
LIHEAP	Low Income Home Energy Assistance Program
LPG	Liquefied Petroleum Gas
MMBtu	Mean Million British Thermal Units
NHIS	National Health Interview Survey
OMB	Office of Management and Budget
ORNL	Oak Ridge National Laboratory
PY	Program Year
RECS	Residential Energy Consumption Survey
SIPP	Survey of Income and Program Participation
SSE	Steady State Efficiency
SOW	Scope of Work
SSI	Supplemental Security Income
TANF	Temporary Assistance for Needy Families
TH	Therm
Therm	100,000 British Thermal Units
WAP	Weatherization Assistance Program

ACKNOWLEDGMENTS

The work presented in this report was funded by the U.S. Department of Energy's (DOE) Office of Weatherization and Intergovernmental Programs (OWIP).

This report summarizes the findings from a study of the households that were eligible for the DOE's Weatherization Assistance Program (WAP) in Program Year (PY) 2008. This study analyzed public use data sets from national household surveys to identify and characterize eligible households and housing units.

The original study design was developed by staff from the Oak Ridge National Laboratory (ORNL) as one component of the National Evaluation of the Weatherization Assistance Program. (*National Evaluation of the Weatherization Assistance Program: Preliminary Evaluation Plan for Program 2006 – ORNL/CON-498).* As part of the evaluation plan development, the design team consulted with and received feedback from the Network Planning Committee, 41 individuals from the weatherization network.

ORNL contracted with the research team of APPRISE Incorporated, the Energy Center of Wisconsin, Michael Blasnik and Associates, and Dalhoff Associates LLC to conduct the National Evaluation. APPRISE took primary responsibility for the design and implementation of this study.

We would like to acknowledge the assistance and guidance of ORNL, DOE Project Officers, and Department of Energy Headquarters Staff.

David Carroll
Chisoo Kim

EXECUTIVE SUMMARY

The purpose of this report is to disseminate the findings from an analysis of the characteristics and energy needs of low-income households that are income-eligible for the Weatherization Assistance Program (WAP). The analysis made use of data from a number of national household surveys; most of the statistics were developed from the Current Population Survey (CPS), the Residential Energy Consumption Survey (RECS), and the American Housing Survey (AHS). This study was conducted as part of the National Evaluation of the WAP for Program Year (PY) 2008.

Background

The U.S. Department of Energy's (DOE) WAP was created by Congress in 1976 under Title IV of the Energy Conservation and Production Act. The purpose and scope of the Program as currently stated in the Code of Federal Regulations (CFR) 10 CFR 440.1 is "to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, persons with disabilities, families with children, high residential energy users, and households with high energy burden." (Code of Federal Regulations, 2011)

At the request of DOE, Oak Ridge National Laboratory (ORNL) developed a comprehensive plan for a national evaluation of WAP that was published in 2007. DOE furnished funding to ORNL in 2009 for a national evaluation for PY's 2007 and 2008, with a particular emphasis on PY 2008. The Scope of Work (SOW) for the evaluation includes:

- Impact Assessment – A broad-based assessment of the population served by WAP and the energy and nonenergy impacts resulting from the program.
- Process Assessment – Observation of how the weatherization network delivers services and assessment of how service delivery compares to national standards.
- Special Technical Studies – Examination of the performance of the program with respect to technical issues such as air sealing, duct sealing, furnace efficiency, and refrigerators.
- Synthesis Study – Synthesis of the findings from this evaluation into a comprehensive assessment of the success of the program in meeting its goals and identification of key areas for program enhancement.

This analysis of the eligible population is part of the Impact Assessment for the program. The information developed in this report is applied to all of the study components.

Study Overview

As defined for this study, low-income households in the United States are a diverse group of families and individuals with one common characteristic: they had household income at or below the eligibility threshold set by the WAP regulations for PY 2008. The challenge for this study is to both characterize the overall population of low-income households in terms of their energy needs and segment the population into groups of households that are distinct in terms of the way that WAP could best serve them. The study addresses this challenge by documenting the individual dimensions of the population and looking at how those interact in the context of WAP service delivery. The individual dimensions examined in this study include:

- Eligible Population – How many households are income-eligible for the program?
- Demographic Characteristics – How do households vary in terms of household composition, income and sources of income, racial/ethnic groups?
- Priority Households – What share of income-eligible households fall into one or more priority groups?
- Health Indicators – What is the incidence of health conditions for individuals in low-income households that might be affected by WAP service delivery?
- Housing Unit Characteristics – How do the housing units that low-income households occupy vary in terms of their housing unit type, size, and energy using systems?
- Housing Quality Indicators – What is the incidence of housing quality problems for housing units that might be addressed by or present barriers to the WAP?
- Energy Expenditures and Consumption – What is the distribution of energy expenditures and consumption for low-income households?
- Energy Affordability Indicators – What is the incidence of energy affordability problems among low-income households that demonstrate a need for the WAP?

For all of these dimensions, the study assessed whether there were important differences by Climate Zone and Census Region. Figure 1 on the next page shows how states were assigned to Climate Zones for this study. Figure 2 on the next page shows how states are assigned to Census Regions.

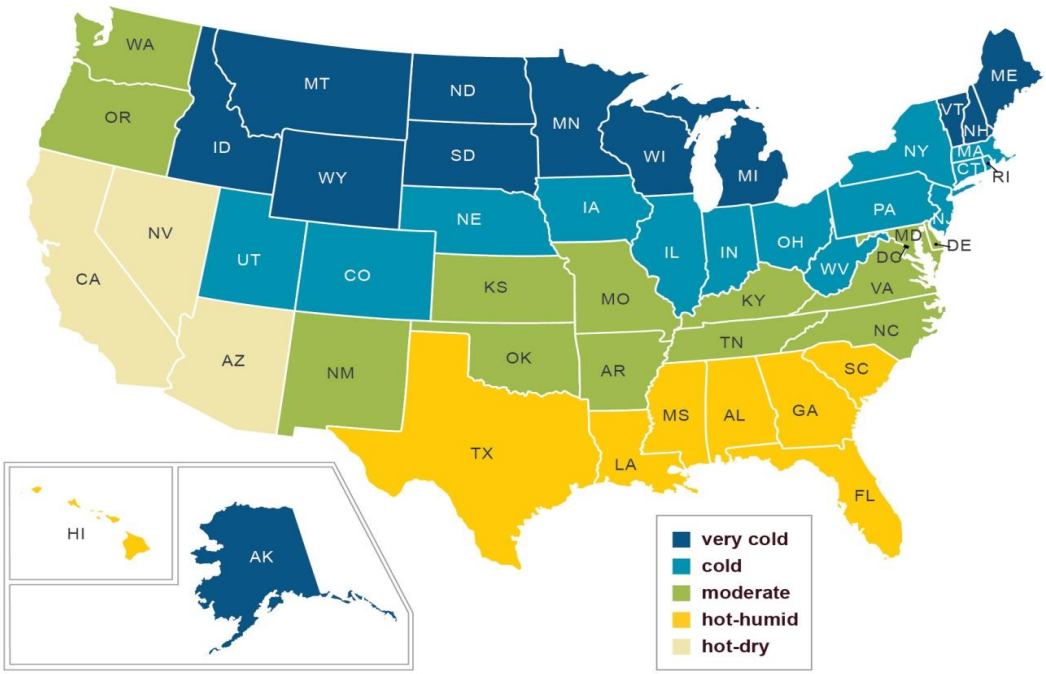

Figure 1. Climate zone map for the PY 2008 evaluation

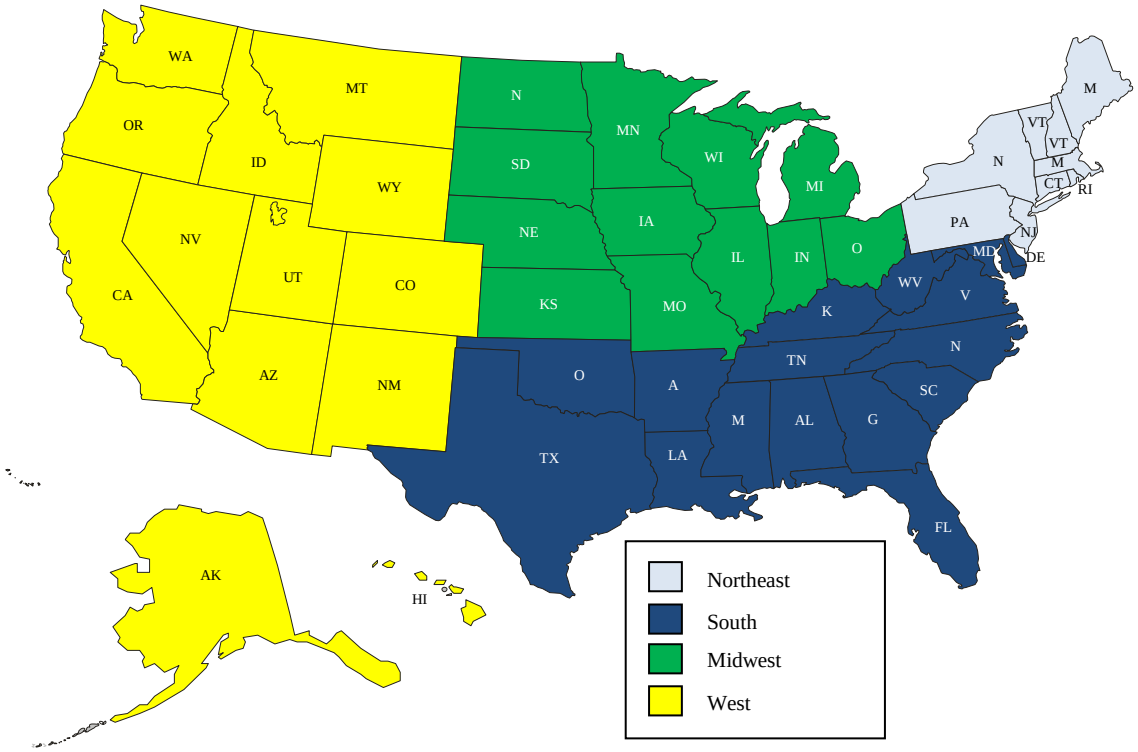

Figure 2. Census region map

Data Sources

All of the data sources used for this analysis are national studies conducted by Federal Statistical Agencies and overseen by Office of Management and Budget (OMB). Each study has a particular focus that furnishes some important information about low-income households. The set of studies together can be used to develop a complete picture of the low-income households served by WAP. The studies used in this research are:

- 2005 Residential Energy Consumption Survey (RECS) – Furnishes data on energy consumption and expenditures, energy-related characteristics of housing units, and energy insecurity.

- 2009 Current Population Survey Annual Statistical and Economic Supplement (CPS ASEC) – Furnishes national and regional estimates of the number of low-income households based on their 2008 income and their demographic characteristics.

- 2007 American Housing Survey (AHS) – Furnishes national and regional estimates of housing unit characteristics, the costs of housing, and housing quality for 2007.

- 2008 American Community Survey (ACS) – Furnishes state-level and sub-state estimates of the number of low-income households in different racial and ethnic groups.

- 2004 Panel of the Survey of Income and Program Participation (SIPP) – Furnishes data on household income sources and dynamics, and adult and child well-being statistics.

- 2008 National Health Interview Survey (NHIS) – Furnishes data on the health status of individuals, including the incidence and impacts of health problems.

All of these studies are conducted on a periodic basis. In all cases, this study used the data from the last study during or prior to WAP PY 2008.

Number of Income-Eligible Households

The Federal Government funds a number of different programs that assist households with limited income, including WAP. Each of those programs establishes guidelines that define the maximum income allowable for program participants. For some programs eligibility is based on the income of an individual (e.g., SSI), while for others (including WAP) eligibility is based on the combined income of all household members. In addition, the programs vary in terms of the income threshold that they use.

This study defines households that are income-eligible for the PY 2008 WAP as being "low-income" households. Under the PY 2008 WAP program regulations, states were allowed to set their maximum income eligibility standard using either "the DOE criteria of 150 percent of poverty or the Low Income Home Energy Assistance Program (LIHEAP) criteria." The LIHEAP criteria for any grantee in Fiscal Year (FY) 2008 was the greater of 150 percent of poverty or 60 percent of state median income. For PY 2008, the LIHEAP criteria made more households eligible for WAP than did the DOE criteria in all states.

In PY 2008, about 35.0 million households were income-eligible for WAP (i.e., low-income) using the LIHEAP criteria, representing about 30 percent of all U.S. households (Figure 3).[1]

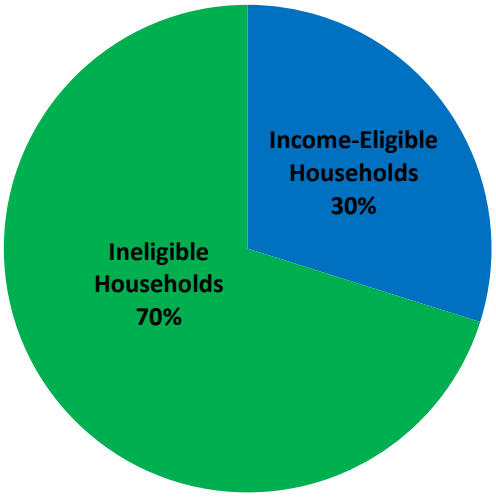

Figure 3. Percent of households income-eligible for WAP in PY 2008

Figure 4 presents information on the distribution of low-income households by Climate Zone. The Cold Climate Zone has the largest number of low-income households.

[1] This is the maximum number of income-eligible households if each state selected the highest income standard. Since each state is allowed to choose between the WAP criteria and the LIHEAP criteria, the actual number of households that were eligible for the program in PY 2008 was less than this number.

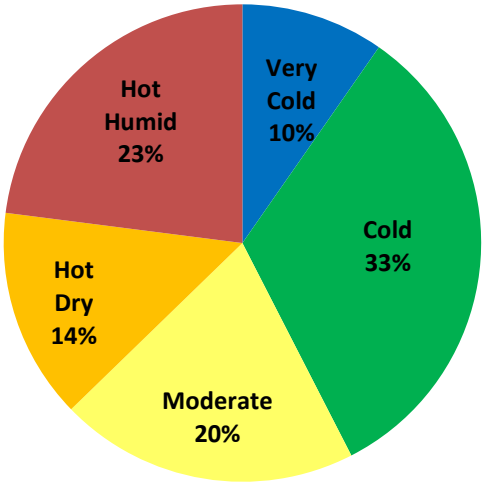

Figure 4. Distributions of low-income households by climate zone in PY 2008

Figure 5 presents information on the distribution of low-income households by Census Region. The South Census Region has the largest number of low-income households. Figures 1 and 2 show that some states in the South Census Region are located in the Hot/Humid Climate Zone (e.g., Florida) while others are located in the Moderate Climate Zone (e.g., Tennessee).

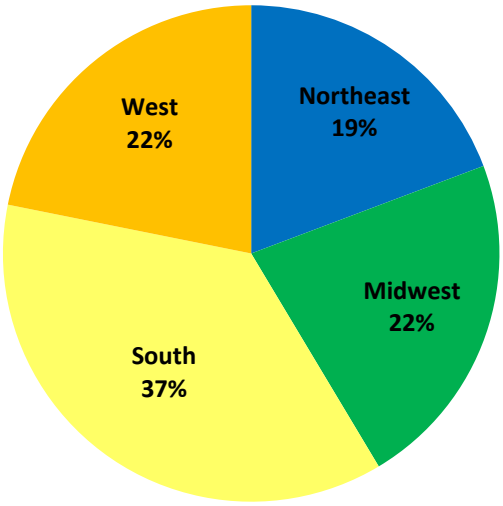

Figure 5. Distribution of low-income households by census region in PY 2008

During the ARRA period, and going forward, the income threshold for WAP eligibility was increased and more households were classified as low-income by the WAP.

- In PY 2010, both the DOE criteria and the LIHEAP criteria were increased making more households income-eligible for WAP. Using those standards, the number of income-eligible households in PY 2008 would have increased from 35.0 million to 45.2 million households, representing 39 percent of all households.[2]

- In PY 2012, the DOE criteria remained at the higher level (i.e., 200 percent of poverty), but the LIHEAP criteria returned to the PY 2008 level. Using the PY 2012 standards 37.2 million households (32 percent of the population) would have been income-eligible for WAP in PY 2008.

At this time of this report, the PY 2012 eligibility threshold will be the one that will be used for future program years.

Characteristics of Low-Income Households

This study examined household characteristics that distinguish different groups of low-income households, including:

- Vulnerable Individuals – The presence of elderly or disabled persons, or children in the home.

- Household Structure – The number and types of individuals that make up the household.

- Income Sources – The primary sources of income for the household.

- Racial/Ethnic Group – The race and ethnicity of the household members.

- Chronic Health Conditions – The incidence of chronic health conditions.

One important household characteristic of interest to the WAP is the presence of vulnerable household members that might be more susceptible to illness caused by homes that are too hot or too cold. By regulation, the WAP gives priority to households with vulnerable individuals. However, analysis of the CPS ASEC data shows that most low-income households (84 percent) have one or more vulnerable individuals. Further, analysis by Climate Zone and Census Region data shows that this finding is consistent throughout the country.

Within the population of households with a vulnerable individual, there are some groups that might be of special interest to the program because they might be considered more susceptible to heat and cold stress, including:

- Older Individuals – For purposes of this study, elderly was defined as being 60 years old or older. About 40 percent of low-income households include an elderly person using this definition. But,

[2]This estimate was developed using income data reported by CPS Survey respondents in PY 2008. Because of the recession in 2008, the actual number of income-eligible households in 2010 was likely to have been higher than this estimate.

about 20 percent of low-income households include a person 75 years old or older; such individuals might be considered to be, on average, more vulnerable than individuals who are 60 to 74 years old.[3]

- Younger Children – For purposes of this study, a child was defined as being 18 years old or younger. About 38 percent of low-income households included a child using this definition. However, about 19 percent of low-income households have a child 5 years old or younger; such children might be considered to be, on average, more vulnerable than children who are 6 to 18 years old.

- Non-Elderly Disabled Adult – About 27 percent of low-income households were classified as having a disabled adult in the household. About one-third of those had an elderly disabled person, while about two-thirds had a non-elderly adult that was disabled.

The structure of households also is useful to consider in the context of service delivery and program impacts. Figure 6 shows the distribution of households by type. About 23 percent of low-income households consist of a single elderly individual and about 13 percent consist of a single parent family. These two groups of households have high poverty rates and are more vulnerable to health risks from homes that are too hot or too cold.

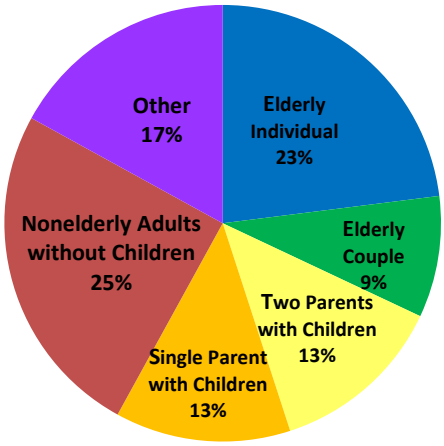

Figure 6. Distribution of low-income households by household type in PY 2008

Figure 7 shows the distribution of income sources for low-income households. Over 50 percent of low-income households reported having wage earnings during PY 2008 and for 47 percent of households wages were the primary source of income. For about 36 percent of households Social Security or other sources of retirement income was the primary source of income.[4] Only 6% of low-income households report that public assistance was their primary source of income. The median income for low-income households in PY 2008 was about $16,800.

[3] NHIS data show that individuals that are 60 or older have higher rates of diabetes, heart problems, and hypertension than individuals that are younger than 60. Individuals who are 75 or old have a higher rate of diabetes and heart disease than individuals who are 60 to 74 years old.

[4] It is important to remember that there is not a direct relationship between the number of elderly households and the number of households with retirement as the primary source of income. Some elderly households have wages as their primary source of income and some non-elderly households have retirement as their primary source of income.

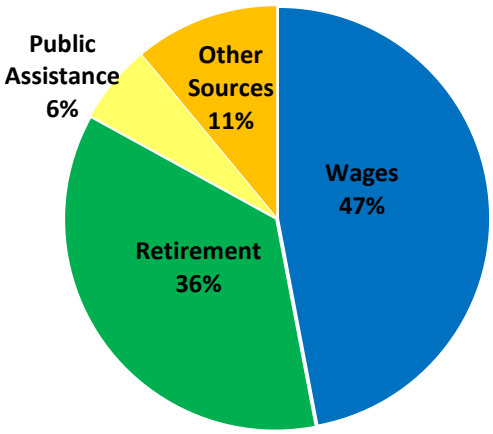

Figure 7. Distribution of low-income households by primary income source in PY 2008

The CPS ASEC data also show how diverse low-income households are in terms of racial and ethnic backgrounds. Figure 8 shows that 56 percent of low-income households have a white non-Hispanic head of households, while 17 percent are black non-Hispanic and 16 percent are Hispanic. Other groups make up the remaining 10 percent of the population. However, those distributions vary considerably by Climate Zone and Census Region. In the Hot/Dry Climate Zone, Hispanic households are 39 percent of low-income households while white non-Hispanic households are 37 percent and black non-Hispanic households are 8 percent. In the Very Cold Climate Zone, white non-Hispanic households are 75 percent of all low-income households.

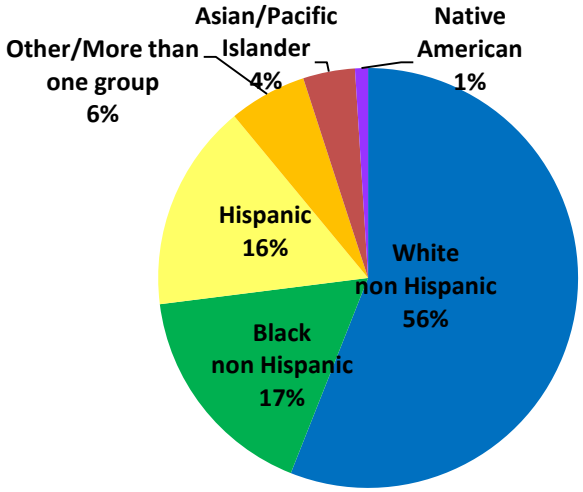

Figure 8. Distribution of Low-Income Households by Racial/Ethnic Group in PY 2008

The ACS data report that about 10 percent of households are linguistically isolated – have no individual in the household that can speak English "well" or "very well." About 7 percent of households speak Spanish as their primary language and are linguistically isolated and about 3 percent of households have a primary language other than English or Spanish and are linguistically isolated.

Many low-income households have individuals with chronic medical conditions that can be affected by the delivery of WAP services. As demonstrated in Figure 9 below, low-income households are much more likely to have an adult with asthma, diabetes, hypertension, and other heart problems or a child with asthma than non-low-income households. Figure 9 shows the rate at which each of those conditions is found in low-income households. The findings from the analysis include the following:

- Adult Asthma - 8 percent report having one or more adults with asthma.
- Childhood Asthma - 13 percent report having one or more child with asthma.
- Adult Diabetes - 10 percent report having one or more adults with diabetes.
- Adult Hypertension - 6 percent report having one or more adults with hypertension

For individuals with circulatory problems (e.g., diabetes or hypertension) weatherization can improve the consistency of temperature in the home and thereby improve the ability of the individual to regulate his/her body temperature. For individuals with asthma, weatherization can improve air quality by reducing the influx of contaminants from outside the home. However, when weatherization services are delivered to homes with an individual who has asthma, it is important for special attention to be paid to ensuring that the home has adequate ventilation and that all moisture issues have been addressed. It is also important that the home has air conditioning to reduce humidity and outdoor contaminants during the cooling season.

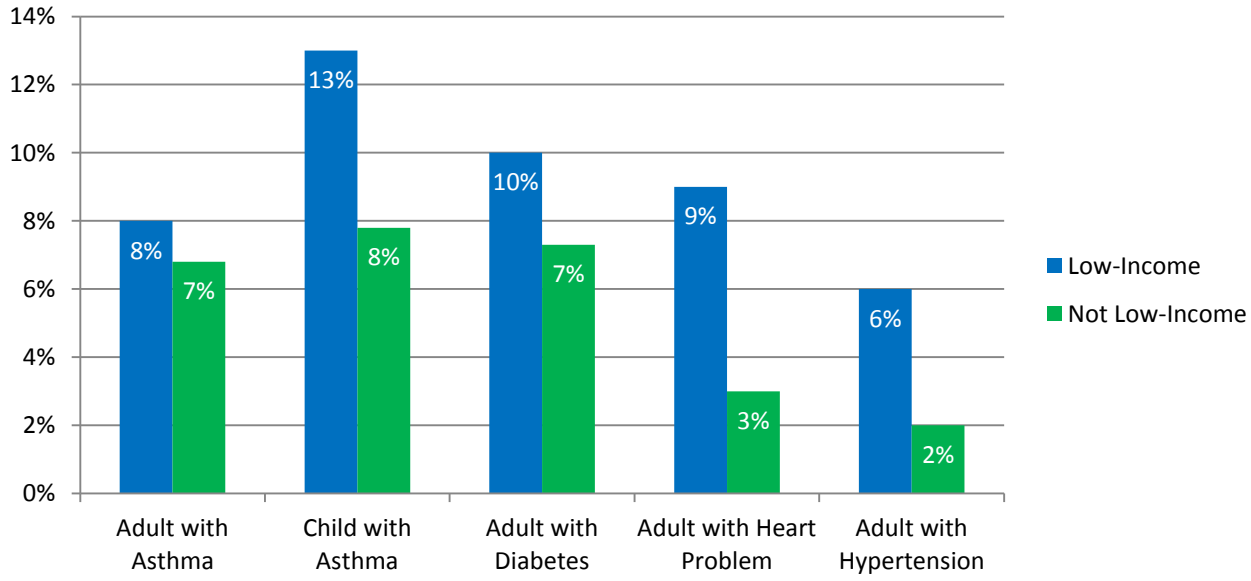

Figure 9. Percent of low-income and non-low-income households with health problems in PY 2008

Characteristics of Low-Income Housing Units

This study examined housing unit characteristics that distinguish different groups of low-income households, including:

- Housing Unit Type – The distribution of low-income households to single family homes, mobile homes, small multi-family homes, and large multi-family homes.

- Home Ownership – The incidence of home ownership.

- Space Conditioning Fuel/Equipment – The way that homes are heated and cooled.

- Energy Efficiency Opportunities – The percent of households with older equipment and homes that need additional air sealing and/or insulation.

The procedures and techniques for weatherizing a home vary considerably by housing unit type. A single family detached home is a self-contained unit where it is important to identify the thermal boundary of the unit and especially to consider how to treat the basement, attic, and any additions to the home. In a large multi-family building, there are many individual units. In some cases the entire building should be treated as one unit, and in others, it is appropriate to treated individual units or subsets of units. Mobile homes, single family attached homes, and small multi-family homes each present special weatherization challenges.

Figure 10 shows that about one-half of low-income households live in single family detached homes and that about one-fourth live in large multi-family buildings. The other three housing unit types – mobile homes, single family attached homes, and small multi-family homes each have about 10 percent of low-income households. In terms of geography, the Northeast Census Region stands out as having more multi-family buildings than other areas; about one-half of low-income households live in either a large multi-family (32 percent) or small multi-family unit (17 percent) compared to about 30 percent of households in other Climate Regions and Census Zones in multi-family homes.

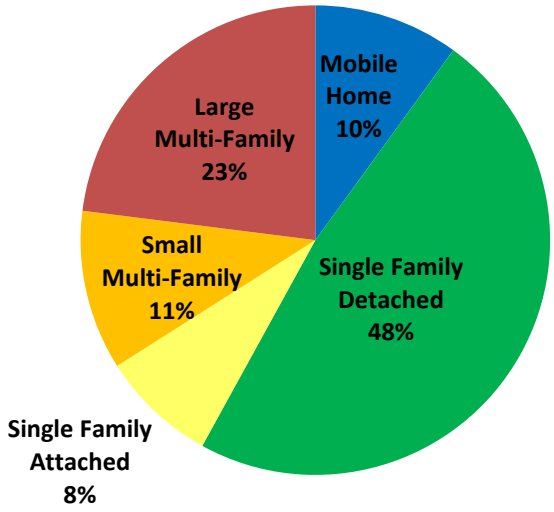

Figure 10. Distribution of low-income households by housing unit type in 2005

The average size of low-income housing units varies considerably by type; the average single family detached home is over 1,500 square feet, while mobile homes and multi-family homes are only about one-half that size (about 800 square feet). Single family attached homes average about 1,200 square feet.[5]

Home ownership also is very different by housing unit type. Overall, about one-half of low-income households own their home. However, as Figure 11 shows, about 80 percent of households living in

[5] Source: 2005 Residential Energy Consumption Survey (RECS)

single family detached homes or mobile homes are homeowners, while only about 12 percent of households in multi-family buildings are homeowners. About one-third of low-income households in single family attached homes are homeowners. Under Section 440.22 of the Federal WAP Regulations, certain conditions must be met if rental units are weatherized using program funds, making it more difficult to weatherize rental units, particularly in multi-family buildings.

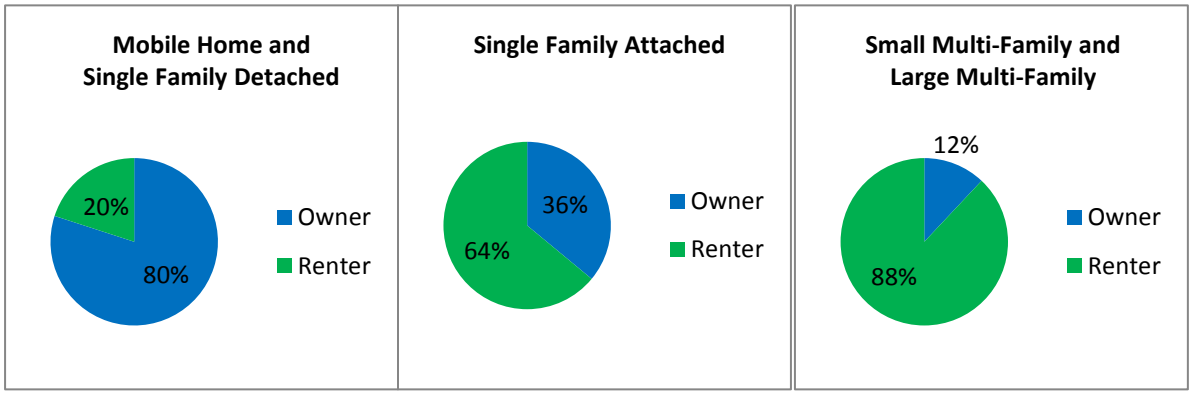

Figure 11. Distribution of ownership by housing unit type for low income households

The main heating fuel and equipment used by a low-income household has a major effect on the recommended procedures for weatherization in terms of the way the home is assessed for health and safety, and in terms of the opportunities for energy efficiency improvements. For fossil fuels (e.g., fuel oil, natural gas), it is important to assess combustion energy efficiency and safety of the heating unit to determine whether there is an opportunity to increase energy savings and safety through furnace replacement. With direct electric heat (e.g., electric baseboard) there are fewer such opportunities short of replacing the entire heating system. If the housing unit has an electric heat pump, ensuring that the system is operating properly can increase energy efficiency. There are clear geographic patterns in the heating fuels and equipment, but it also is true that every weatherization agency is likely to encounter any and all of the different equipment and fuel types in delivering services.

Figure 12 shows the distribution of heating fuel among low-income households. About one-half of low-income households have natural gas main heat, about one-third have electricity, and the remaining 20 percent use fuel oil, LPG, wood, or some other heating source. In terms of Climate Zone, the colder regions are more likely to use fossil fuels; only 15 percent of low-income households in the Cold Climate Zone have electric main heat compared to 65 percent in the Hot/Humid Climate Zone. In terms of geography, about one-third of low-income households in the Northeast Census Region have fuel oil main heat and one-half use natural gas while 72 percent of the households in the Midwest Census Region have natural gas main heat.

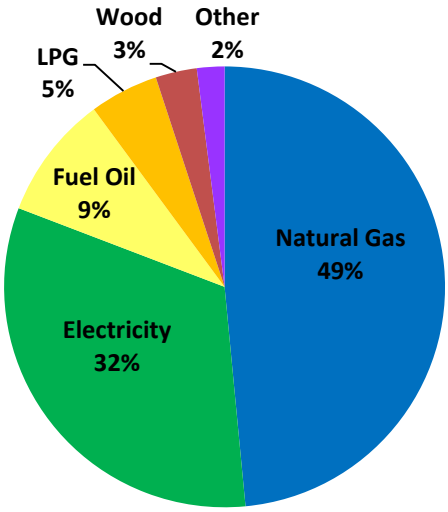

Figure 12. Distribution of low-income households by main heating fuel in 2005

Most low-income households have ducted (warm air blown through ducts) or hydronic heating systems (hot water or steam delivered through pipes). Figure 13 shows that about 80 percent of low-income households have one of those two types of heating systems. These systems are generally more complex in that most require assessment of the combustion safety and efficiency of the equipment as well as examining the operation of the distribution system. About 15 percent have either vented room heaters or electric baseboard units. These units present their own special challenges. About 4 percent of low-income households use unvented room heaters or portable electric heaters for their main heat. The unvented units are unsafe since combustion by-products are exhausted into the living space. The portable electric units present a fire and health hazard in the home. About 12 percent of low-income households in the Hot/Humid Climate Zone have one of these types of heating systems.

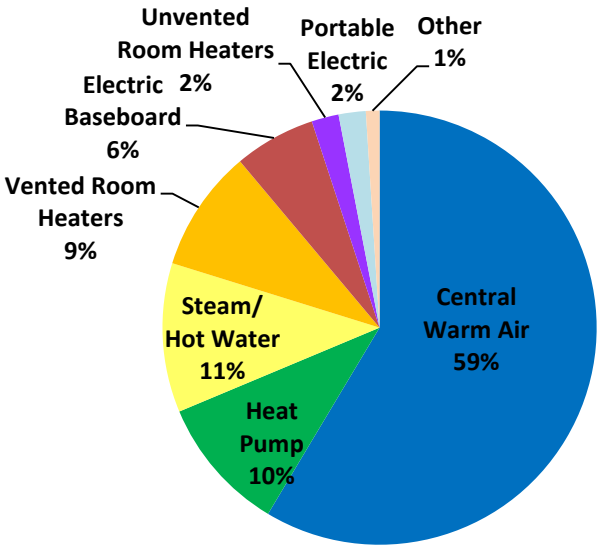

Figure 13. Distribution of low-income households by main heating equipment type in 2007

Most low-income households have some form of cooling equipment. About 43 percent of low-income households have a central cooling system and about 35 percent have window or wall units. About one in five low-income households does not have air conditioning. Many of those households are in the Very Cold or Cold Climate Zone. For households with elderly individuals or with individuals with asthma, going without air conditioning can present a serious health risk even in the colder climates. About 41 percent of households in the Hot/Dry Climate Zone report that they do not have air conditioning. Many of those households are in the coastal part of the Hot/Dry Climate Zone states. This part is sometimes called the Marine Climate Zone. It is not clear that air conditioning is as critical for households in this area.

Low-income households with older equipment or homes that are poorly sealed or insulated are more likely to have greater energy saving opportunities. Figure 14 presents a number of indicators that might demonstrate the share of households that have different types of efficiency opportunities.

- Main Heating Equipment – 26% of low-income households report that they have main heating equipment that is 20 years old or older; replacement with a new furnace could result in substantial energy savings.

- Other Major Energy Equipment - 9 percent of low-income households report that their cooling equipment is 20 years old or older, 11 percent have water heating equipment 20 years old or older, and 15 percent have at least one refrigerator that is 20 years old or older.

- Insulation - About 25 percent of households report that their home is poorly insulated or has no insulation.

- Draftiness - About 14 percent of households report that their home is drafty most or all of the time in the winter.

Each of these indicators identifies a household that clearly could benefit from the delivery of weatherization or other energy efficiency services.

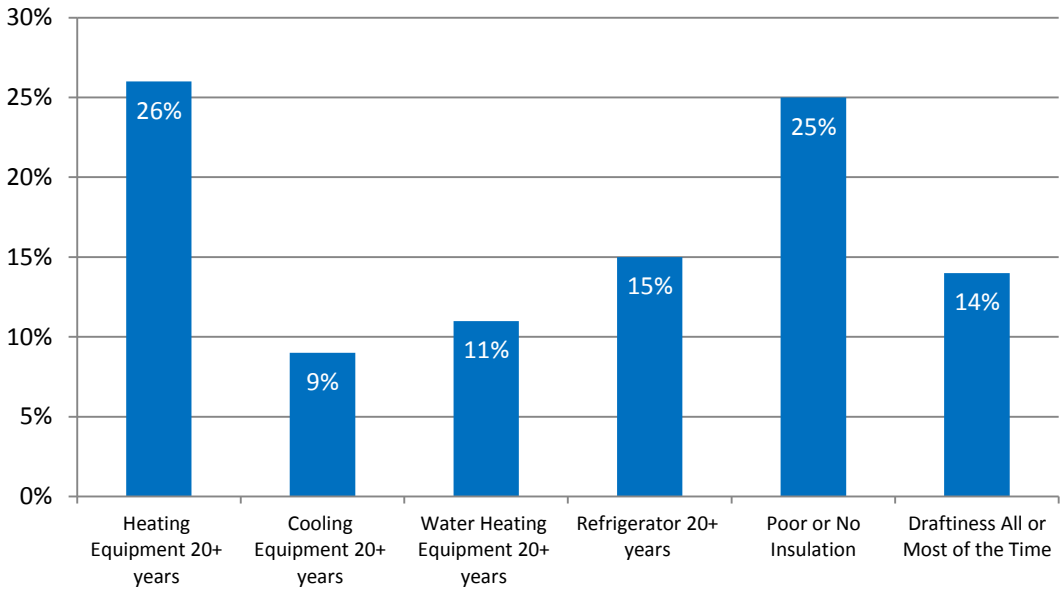

Figure 14. Indicator of energy efficiency opportunities for low-income households

Energy Consumption, Expenditures, and Burden for Low-Income Households

The WAP serves two purposes; it makes energy more affordable for low-income households and it reduces energy consumption in the residential market sector. This study developed energy information for low-income households, including:

1. Expenditures and Burden – Distribution of residential energy expenditures and burden.
2. Consumption – Distribution of energy consumption by fuel type.
3. Affordability – Incidence of indicators of energy affordability.

The study developed summary indicators that help to compare usage by low-income households to usage by households that are not low-income, and to examine how usage varies by Climate Zone and Census Region.

1. Btu per Square Foot – Computed as total Btus (source) divided by the occupied square footage of the home
2. Heating Btu per Square Foot per Heating Degree Day (HDD)– Computed as heating Btus (statistically derived) divided by conditioned square footage and heating degree days (base 65 degrees)
3. Cooling Btu per Square Foot per Cooling Degree Day (CDD) – Computed as cooling Btus (statistically derived) divided by conditioned square footage and cooling degree days (base 65 degrees)

Figure 15 shows the projected energy expenditures for low-income households for PY 2008. Average annual expenditures were $1,869 and about one fourth of households spent more than $2,411 for energy. By comparison, average expenditures for households that were not low-income were projected to be $2,340 for PY 2008, about 25 percent higher than for low-income households. However, mean energy burden for low-income households is 13.9 percent of income, almost four times the burden for non low-income households.

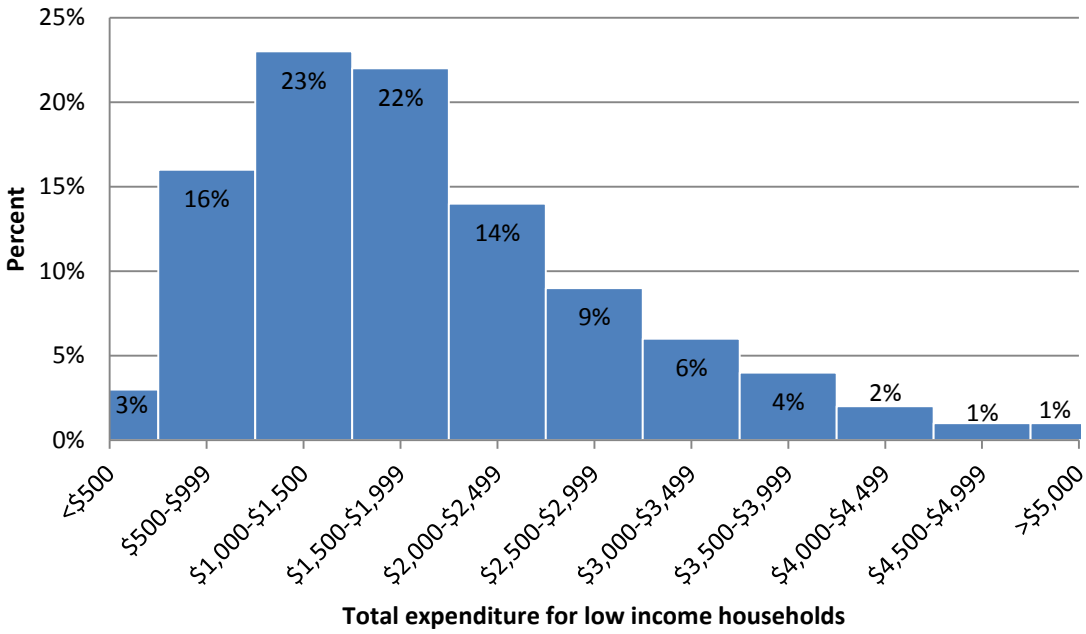

Figure 15. Distribution of projected energy expenditures for low-income households in PY 2008

Figure 16 shows the projected energy burden for low-income households for PY 2008. Average energy burden was 13.9 percent of income and about one fourth of low-income households had burden of 15.3 percent or more. By comparison, average burden for households that were not low-income was projected to be 3.6 percent, about one fourth of the burden for low-income households.

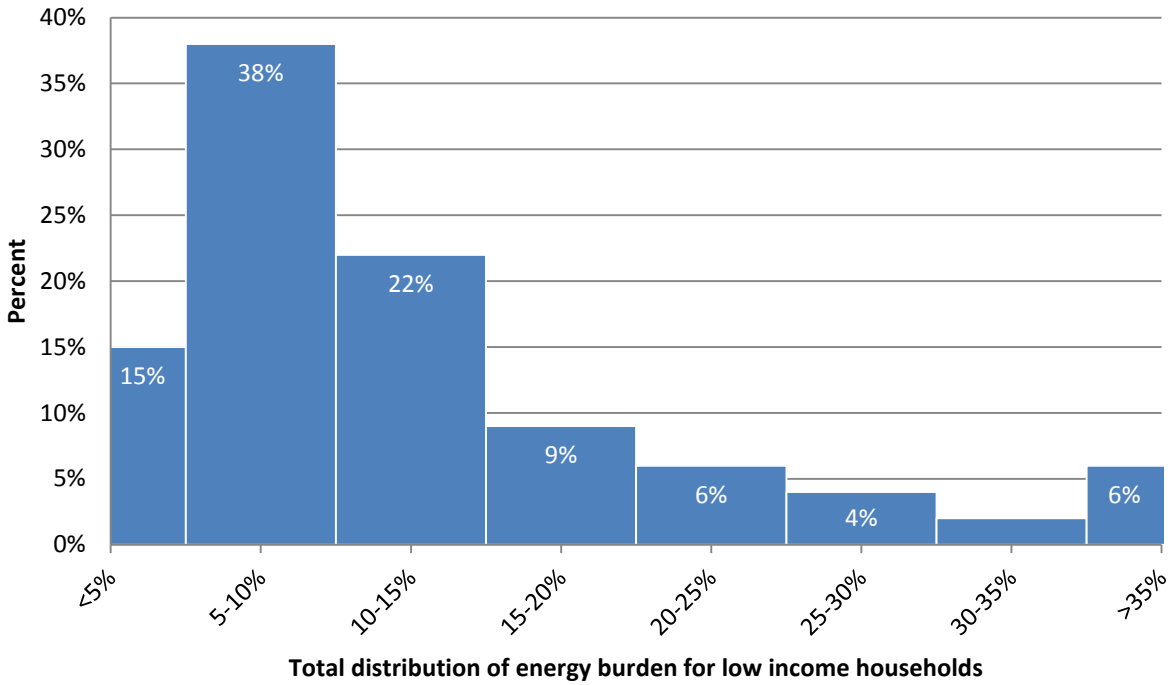

Figure 16. Distribution of energy burden for low-income households in PY 2008

The study developed information on energy expenditures for important sub-populations. Some important findings include:

- End Use Shares – Home heating accounts for about one-third of energy expenditures. Air conditioning, water heating, and refrigeration account for another third. All other end uses, including lighting, account for the remaining third of energy expenditures.

- Main Heating Fuel – Low-income households that heat with fuel oil had the highest average energy expenditures, about 64 percent higher than the average for all households. Those that heat with electricity had the lowest average energy expenditures, about 14 percent lower than the average for all households.

- Housing Unit Type – Households in single family detached homes had the highest energy expenditures, about 15 percent higher than the average. However, households in small multi-family buildings had the highest energy burden because they had much lower average income than low-income households in single family homes.

- Demographic Group – Households with children had the highest energy expenditures. Elderly households had expenditures close to the average for low-income households.

- Poverty Group – Households with income at or below the poverty income guideline had the lowest energy expenditures, about 5 percent less than the average. However, because their income is much lower, these households had average energy burden that exceeded 20 percent of income, more than twice the level for any other group.

Ownership status is one important issue for the WAP. About one-half of low-income households are renters, but it is more difficult to weatherize rental units because permission of the building owner is required, and, in most cases, the building owner is expected to contribute to the costs of weatherization of the home. Figure 17 compares energy expenditures for owners and renters for all housing types, and for single family and mobile homes. The first set of bars shows that, for all low-income households, owners have average expenditures of $2,112, about 30 percent higher than for renters. However, when the data are separated by housing unit type, the difference between expenditures for owners and renters is much smaller. Mobile home renters have higher energy expenditures than mobile home owners, and single family renters have expenditures only about 10 percent less than owners.

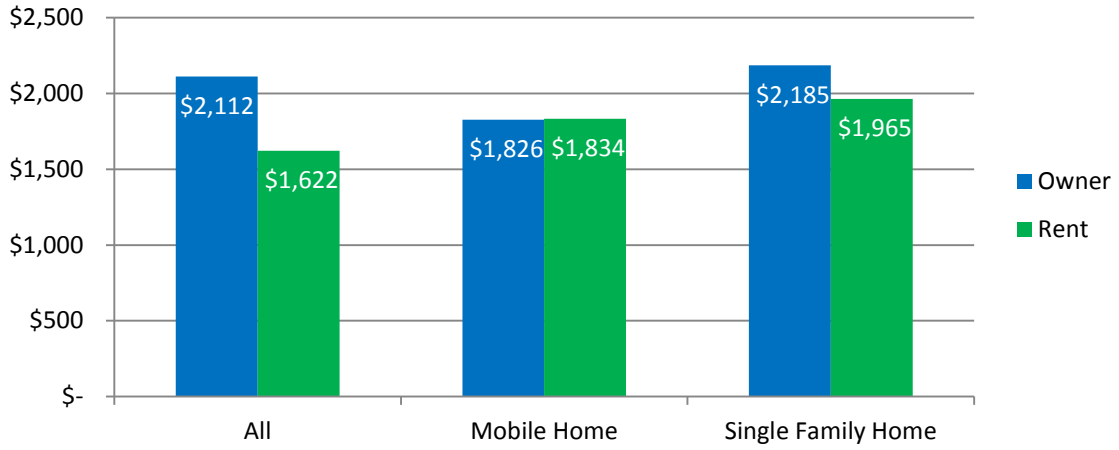

Figure 17. Average energy expenditure statistics by tenure and housing unit type for low-income households in PY 2008

Climate Zone and Census Region are two other important factors to consider in terms of low-income energy expenditures and burden. Figures 18 and 19 show that the Hot/Dry Climate Zone had the lowest average energy expenditures and burden; both were about 30 percent less than the national average.[6] Among the other Climate Zones, average expenditures were highest for the Very Cold Climate Zone and similar across the other three zones. Energy burden was highest in the Hot/Humid Climate Zone because average income was lowest in that Climate Zone.

[6]As shown in Figure 1, the Climate Zones were defined at the state level. Detailed statistics on heating and cooling degree days shows that one-half of the low-income households in this Zone experienced less than 2,000 cooling degree days and less than 2,000 heating degree days. That is the primary reason for the low energy expenditures in this zone. In comparison, almost all of the low-income households in the Hot/Humid Zone have 2,000 or more cooling degree days.

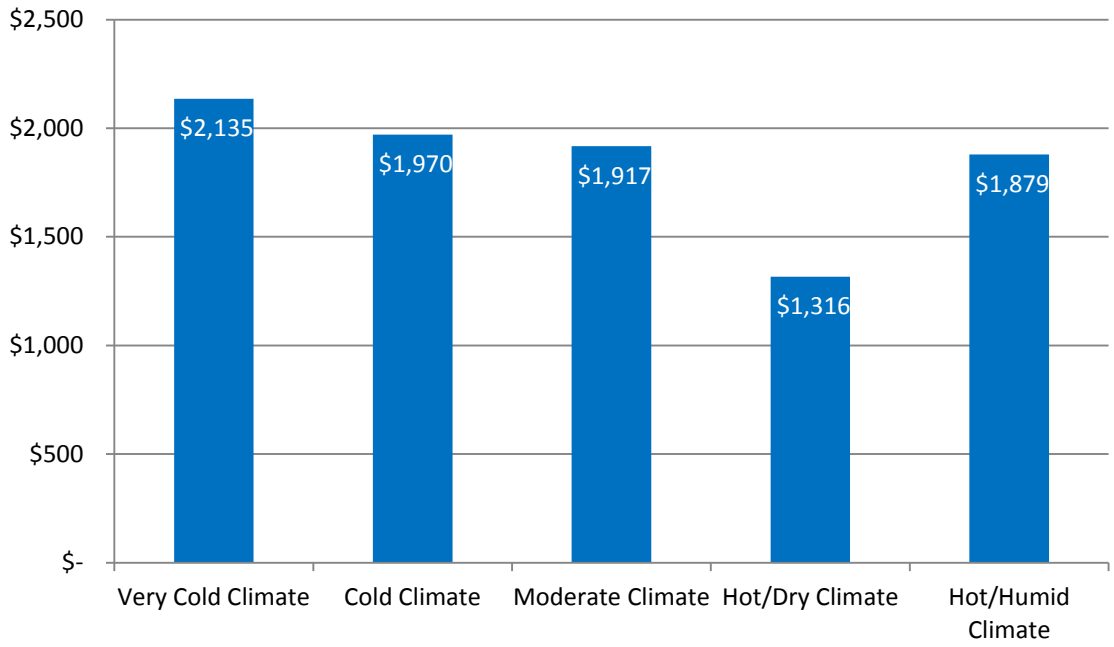

Figure 18. Average energy expenditures for low-income households in PY 2008 by climate zone

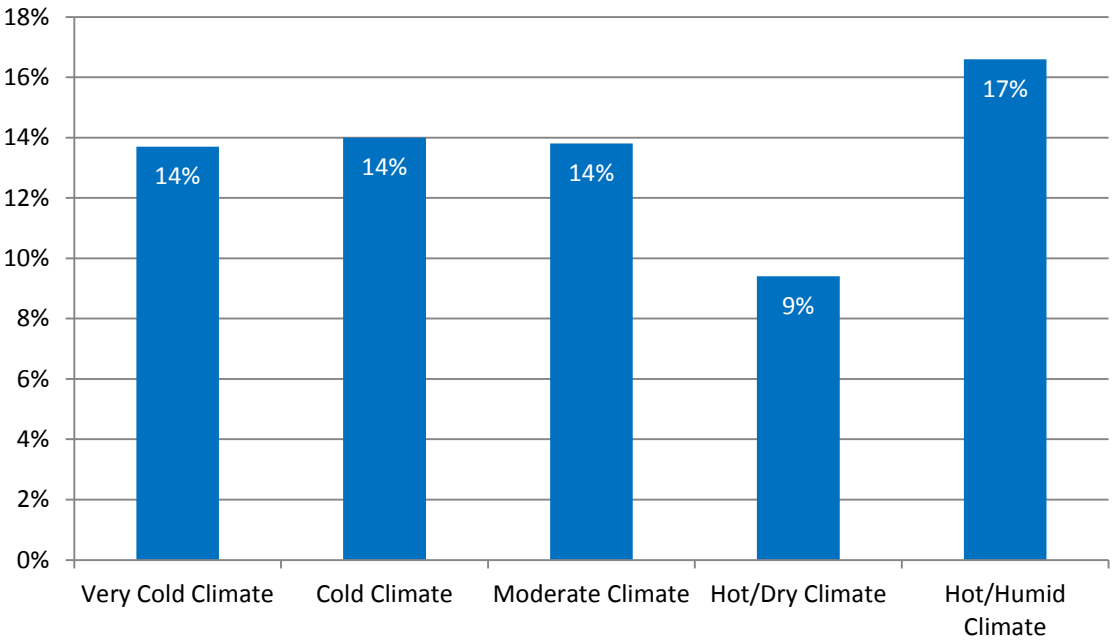

Figure 19. Average energy burden for low-income households in PY 2008 by climate zone

The Northeast Census Region had the highest energy expenditures and burden; expenditures were 25 percent above the average and burden was about 15 percent because of the high incidence of Fuel Oil usage in the Region. The West Census Region has the lowest average expenditures and burden.

Another important difference by Climate Zone is the share of energy expenditures to individual energy end uses. In the Very Cold Climate Zone, almost one-half of energy expenditures are for home heating and only 2 percent are for home cooling. In the Hot/Humid Climate Zone over one-fourth of energy expenditures are for home cooling, while only about 11 percent are for home heating. In the Hot/Dry Climate Zone, over 50 percent of energy usage is for appliances (including lighting).

It is important to understand how high energy expenditures and burden for low-income households are manifested in terms of client affordability, health, and safety. The 2005 RECS included questions that document impacts on low-income households. Key findings include:

- Heat Interruptions – About 9 percent of low-income households were unable to use their main source of heat when it was needed because they had their energy service shut off, or they could not afford to have their energy equipment repaired.

- Cooling Interruptions – About 7 percent of low-income households were unable to use their cooling equipment when it was needed because they had their electric service shut off, or they could not afford to have their air conditioner repaired.

- Other Affordability Problems – Almost 60 percent of households reported having one or more months during the year when they had other energy affordability problems such as reducing expenses for other necessities to pay their energy bill.

- Health and Safety Problems – About 26 percent of households reported having one or more months during the year when they had a health and safety problem such as keeping their home at an unsafe temperature.

One expected outcome from the delivery of weatherization services would be that clients would have a reduced incidence of these problems. A survey of weatherization recipients is being conducted as part of the National Evaluation to measure these program impacts.

The analysis shows that low-income households use different kinds of fuels in their homes. Households use different fossil fuels (e.g., natural gas, fuel oil, and LPG) that are generally reported in different physical units (e.g., ccf, gallons, and pounds). In addition, some households use a fossil fuel for some of their end uses and electricity for others, while other households use electricity for all end uses. That makes it difficult to compare different groups of low-income households in terms of their energy consumption.

One way to compare energy usage is to convert all physical units for fossil fuels to energy content unit – British Thermal Units (Btus). Figure 20 presents the mean million Btus (MMBtus) of energy consumption for households that heat with natural gas, fuel oil, or LPG by Climate Zone and Figure 21 presents the average electric usage (in kWh) for those same households. The figures show that the Very Cold Climate Zone has the highest average consumption for the fossil fuels (in MMBtus), about 25 percent above the national average, but the Hot/Humid Climate Zone has the highest mean consumption of electricity, about 50 percent above the national average. These findings are consistent with the expenditure end use data previously presented: households in the Very Cold Climate Zone have higher expenditures for heating (which most often uses a fossil fuel), while those in the Hot/Humid Climate Zone have higher expenditures for cooling and appliances (which uses electricity). The Hot/Dry Climate Zone has the lowest average usage of both fossil fuels and electricity.

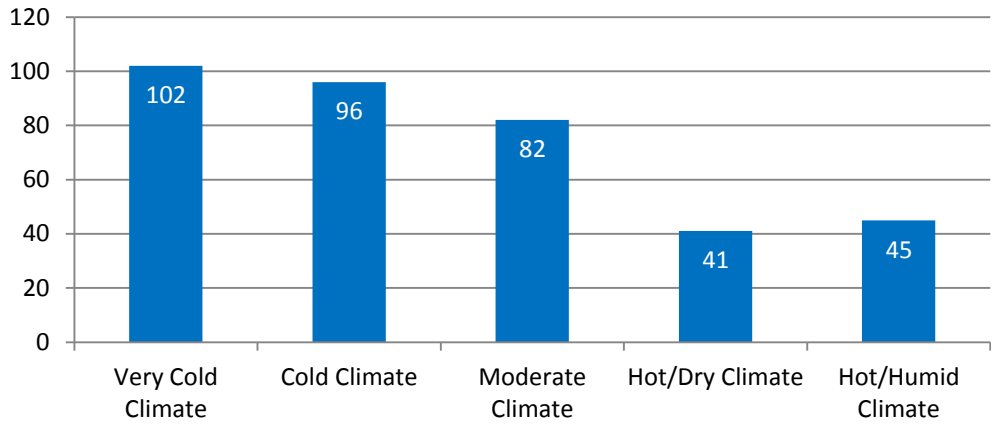

Figure 20. Average fossil fuel consumption (MMBtu) by climate zone for low-income households with natural gas, fuel oil, or LPG main heat

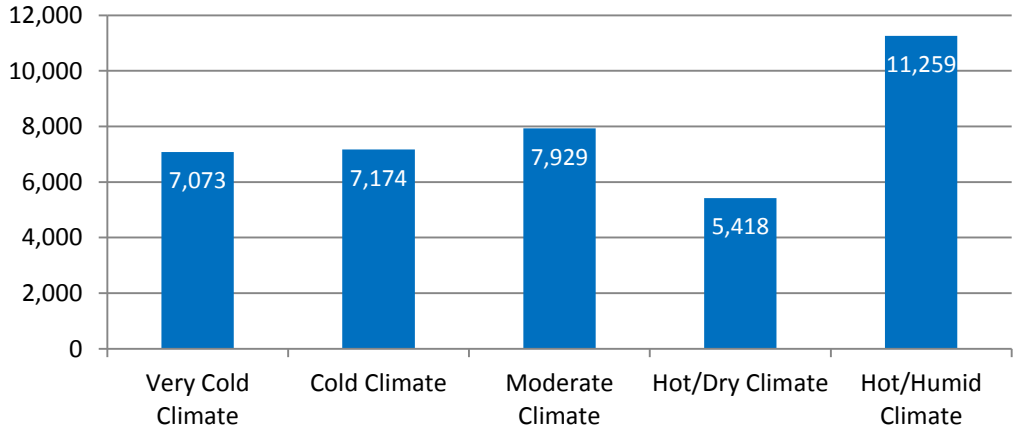

Figure 21. Average Electric consumption (kWh) by climate zone for low-income households with natural gas, fuel oil, or LPG main heat

Figure 22 shows the average electric use by Climate Zone for low-income households that heat with electricity. Average usage is highest in the Hot/Humid Climate Zone, about 10 percent above the national average. Usage in both the Cold and Moderate Climate Zones is about average. The Hot/Dry Climate Zone has the lowest usage, almost 40 percent lower than the average for all low-income households.

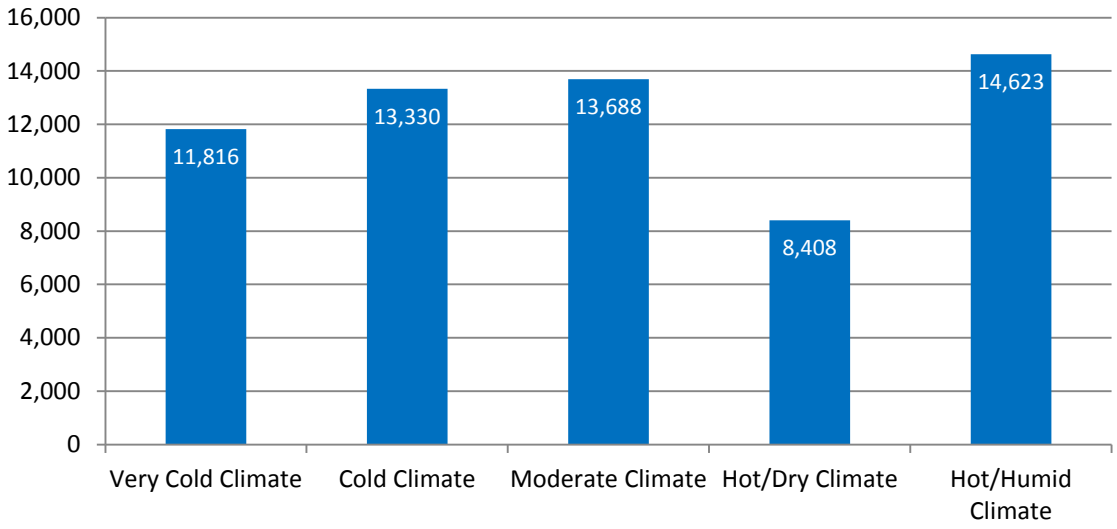

Figure 22. Average electric consumption (kWh) by climate zone for low-income households with electric main heat

The Impact Reports from the 2008 WAP Evaluation have demonstrated that serving higher usage households is associated with both higher total savings and, in many cases, higher percentage savings. This study found that about 30 percent of low-income households that heat with a fossil fuel have energy use of 100 MMBtu or more of fossil fuel, and that about 25 percent of those households use 10,000 kWh or more of electricity even though they don't heat with electricity. The analysis found that 18 percent of low-income households that heat with electricity have usage of 20,000 kWh or more.

One way to compare the energy usage for all low-income households is to convert all energy usage to Btus, including electricity usage. However, if the standard units for electricity – kWh – are converted to Btus, analysts generally consider that conversion to understate the effective Btu content of electricity since the total Btus of fossil fuels that are burned to generate electricity and the energy losses associated with transmission of electricity to the home are greater than the kWh used at the home. For benchmarking purposes, EPA recommends that the *site* Btu factor be multiplied by a factor of 3.34 to get a *source* Btu value for electricity usage. Using that factor the analysis estimated the total Btu of energy consumption for all low-income households. Figure 23 shows the average total energy usage (*source* MMBtu) by low-income households by Climate Zone. The data show that four of the five Climate Zones have similar average usage levels – the Very Cold Climate Zone is highest with about 5 percent more usage than the Moderate Climate Zone. Only the Hot/Dry Climate Zone stands out as being different; energy usage is about one-third less in that Climate Zone than in the other areas.

One way in which the energy usage statistics developed from the RECS are useful is in assessing the relative efficiency of usage for different groups of households. One metric that analysts use for examining energy savings potential is energy usage intensity. Figure 24 shows the heating energy use intensity and the cooling energy use intensity for low-income households by Climate Zone. The Hot/Humid Climate Zone is estimated to have the highest energy use intensity for both heating and cooling. The Hot/Dry Climate Zone has the second highest heating energy use intensity, but the lowest cooling energy use intensity.

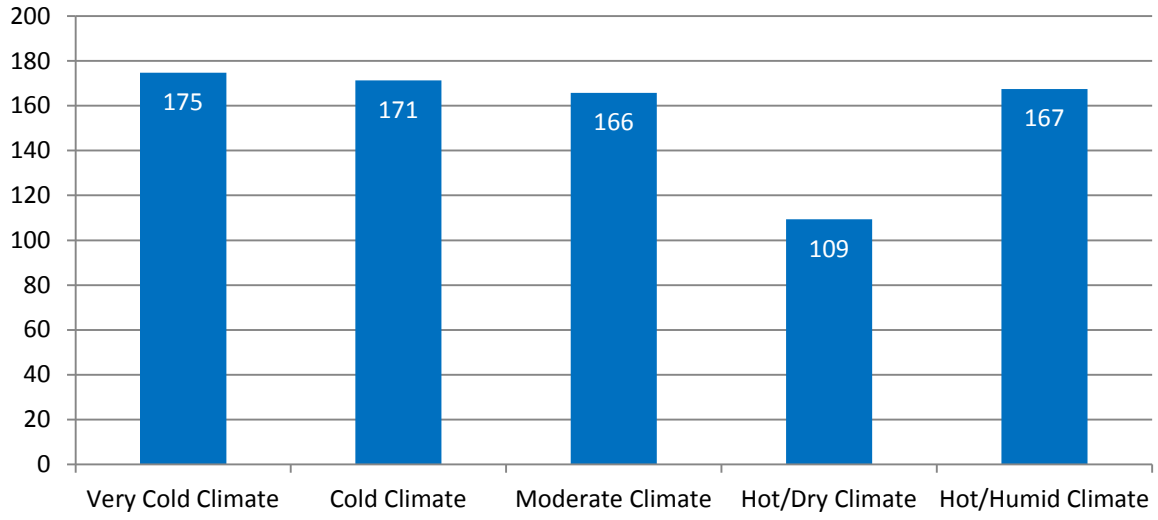

Figure 23. Total energy use (source MMBtus) for low-income households in PY 2008 by climate zone

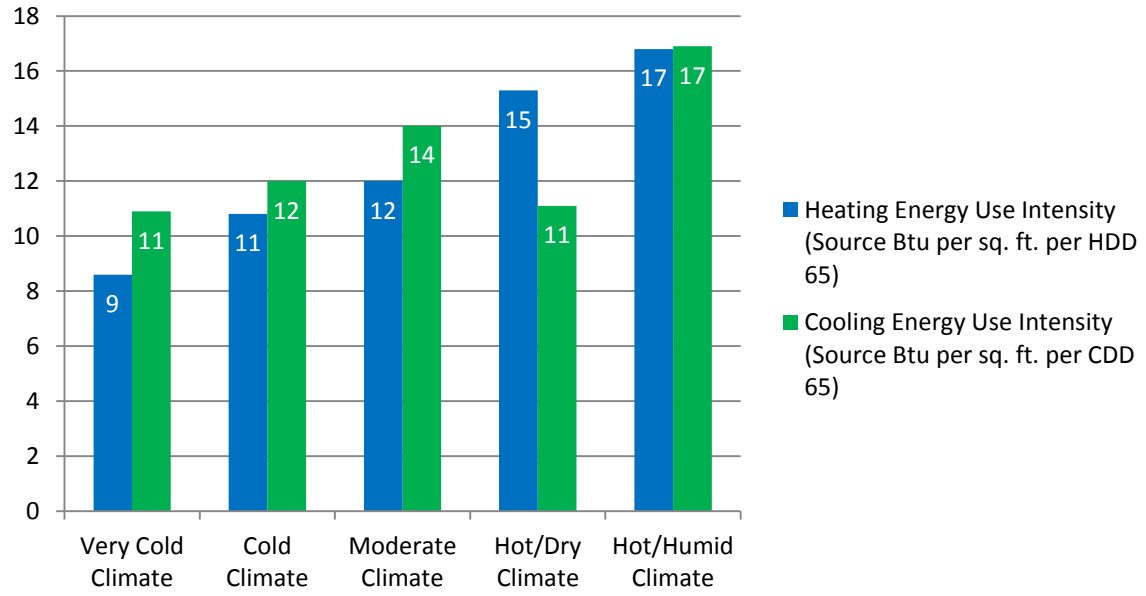

Figure 24. Heating and cooling energy use intensity for low-income households in PY 2008 by climate zone

There is another important geographic component to energy use intensity. Figure 25 shows that the Northeast Census Region has the highest heating energy use intensity and the Midwest Census Region has the lowest, even though both regions include Very Cold, Cold, and Moderate Climate Zones. It is possible that on average the Northeast Census Region has older and less efficient homes than the Midwest Census Region.

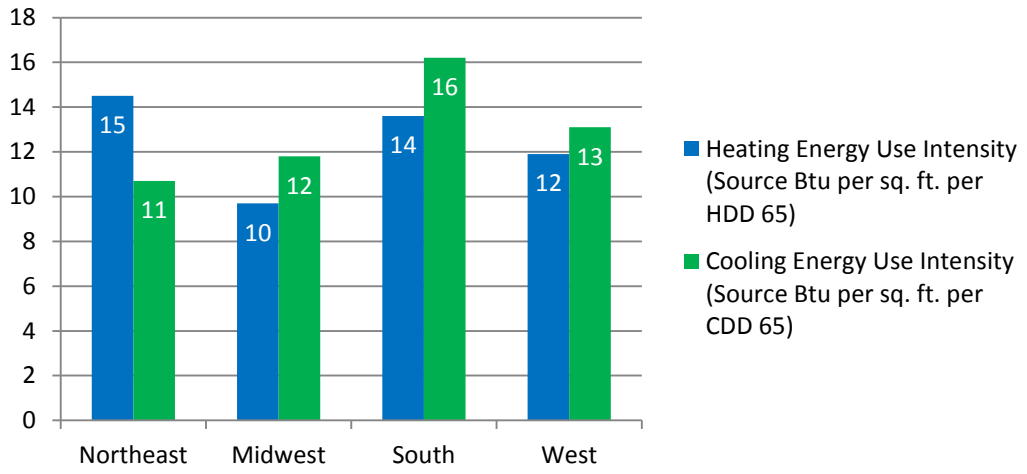

Figure 25. Heating and cooling energy use intensity for low-income households in PY 2008 by census region

The study also developed an experimental indicator of high energy usage and high energy burden. The WAP program regulations direct grantees to target households with high usage and high energy burden. However, the regulations do not define those terms. For purposes of this study, high usage households were defined as those with usage in the top quartile of usage and high burden households were defined as those with burden in the top quartile of energy burden. An experimental definition of high priority households was defined as those households that had both high usage and high burden; about 10 percent met both of those criteria.

Figure 26 compares the distribution of low-income households by Climate Zone to the distribution of priority households (experimental definition). The figure shows that the Moderate Climate Zone has the highest number of priority households according to this exploratory definition; 33 percent of all low income households live in this Climate Zone and 37 percent of all households with both high energy usage and high energy burden live in this Climate Zone.

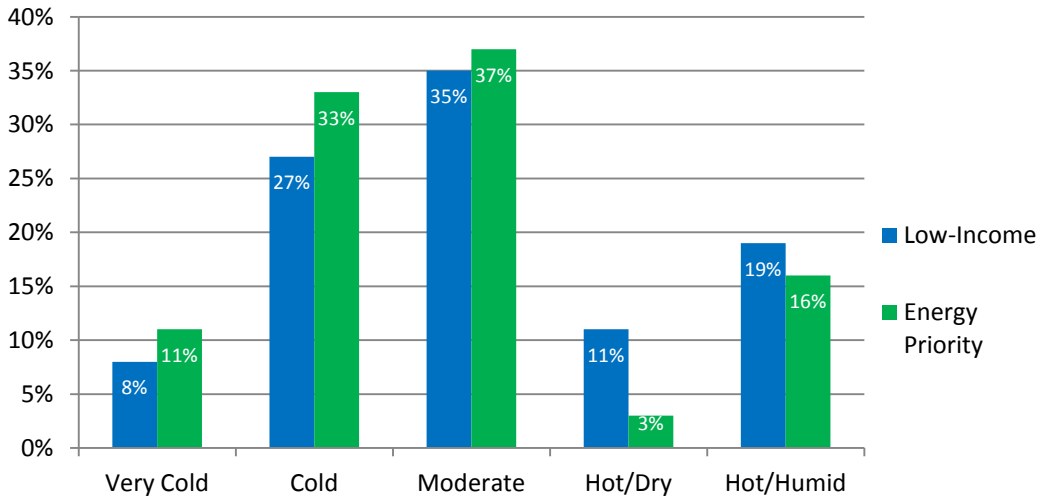

Figure 26. Percent of low-income households and energy priority (experimental) households in PY 2008 by climate zone

Figure 27 compares the distribution of low-income households by Census Region to the distribution of priority households (experimental definition). It shows that 35 percent of households that have both high energy usage and high energy burden live in the South Census Region. The Northeast Region has 29 percent of these households.

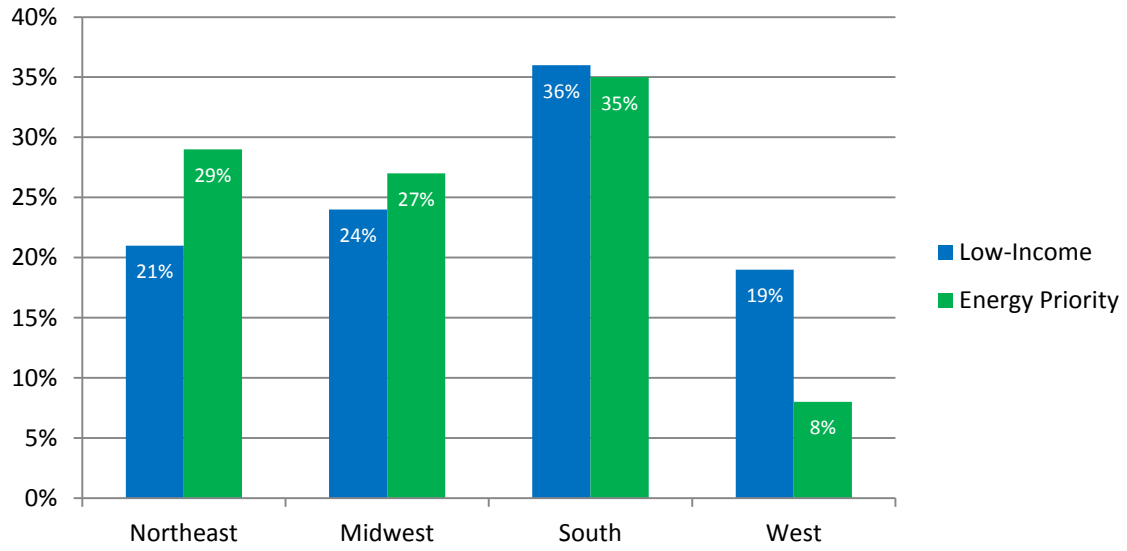

Figure 27. Percent of low-income households and energy priority (experimental) households in PY 2008 by census region

Program Implications

This analysis of the low-income population furnishes information for the WAP program and the WAP Evaluation. Key findings from the analysis include:

- Characteristics of Low-Income Households – The study finds that the population of low-income households is diverse and demonstrates the kinds of challenges that WAP agencies face every day as they try to serve the full range of households in need of energy assistance. Examples include:
    - Elderly Households – About one-third of low-income households have either one elderly person (22%) or an elderly couple (9%) with no other household members.
    - Working Households – Half of all low-income households have wages as their primary source of income.
    - Chronic Health Conditions – The study found that about one fifth of low-income households have one or more persons with respiratory problems (e.g., asthma, chronic bronchitis, sinusitis) that should be considered as the program delivers services to the household.
    - Linguistic Isolation – About 10 percent of low-income households are linguistically isolated (7 percent Spanish and 3 percent Other Languages) and would need assistance to interact effectively with intake workers, auditors, and service delivery crews.

- Characteristics of Low-Income Housing Units – The diversity in housing units occupied by the population of low-income households may present an even greater challenge to the WAP. And, even though housing unit characteristics are more homogeneous within neighborhoods, and even in certain parts of the country, every local WAP sub-grantee is likely to be presented with most or all of the different types of housing, heating equipment, and tenure including:

    - Housing Unit Type – One half of low-income households live in single family detached homes, while one fourth live in large multi-family buildings. The weatherization procedures for those two types of dwellings are very different, even in terms of assessing program eligibility.

    - Heating Equipment – Each type of equipment presents special challenges to the energy auditors and service delivery teams. Forced air furnaces must be checked to ensure that they are operating safely and efficiently, and the ducts may need treatment so that the air is distributed properly without heat losses. Homes that have unvented room heaters should have those heaters replaced so that the combustion gases are no longer entering into the home.

    - Renters – Housing units occupied by renters require permission from the property owner and, in most cases, co-funding by the property owner.

- Energy Consumption, Expenditures, and Burden – The energy data furnished by the RECS survey identify both a challenge and an opportunity for the WAP. The challenge is that households vary widely in the amount of energy used and the purposes for which it is used. However, the national WAP Evaluation's Energy Impact reports show that the highest level of savings and the most cost-effective savings result from treating high usage households. Since WAP Guidelines give grantees the option to prioritize households with high energy usage and high energy burdens, the information developed in this report could be used by program managers to better define these terms and to help subgrantees to prioritize low-income households.

The combined data sources used in this analysis furnish robust statistics on the population of low-income households. The analysis demonstrates the challenges faced by the WAP in delivering services to a diverse population. However, the analysis also presents opportunities for the WAP to maximize both energy and nonenergy program impacts.

1. INTRODUCTION

The purpose of this report is to disseminate the findings from an analysis of the characteristics and energy needs of low-income households that are eligible for the Weatherization Assistance Program (WAP). The analysis made use of data from national household surveys, including the Current Population Survey (CPS), the Residential Energy Consumption Survey (RECS), the American Housing Survey (AHS), the Survey of Income and Program Participation (SIPP), the American Community Survey (ACS), and the National Health Interview Survey (NHIS). The study was conducted as part of the National Evaluation of the Weatherization Assistance Program for Program Year (PY) 2008.

1.1 BACKGROUND

The U.S. Department of Energy's (DOE) WAP was created by Congress in 1976 under Title IV of the Energy Conservation and Production Act. The purpose and scope of the Program as currently stated in the Code of Federal Regulations (CFR) 10 CFR 440.1 is "to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such a the elderly, persons with disabilities, families with children, high residential energy users, and households with high energy burden." (Code of Federal Regulations, 2011)

At the request of DOE, Oak Ridge National Laboratory (ORNL) developed a comprehensive plan for a national evaluation of WAP that was published in 2007 (National Evaluation of the Weatherization Assistance Program: Preliminary Evaluation Plan for Program Year 2006, February 2007). DOE furnished funding to ORNL in 2009 for that plan to be implemented for Program Year's (PY) 2007 and 2008, with a particular emphasis on PY 2008. ORNL subcontracted evaluation research to APPRISE Incorporated and its partners (the Energy Center of Wisconsin, Michael Blasnik and Associates, and Dalhoff Associates LLC). The Scope of Work (SOW) for the evaluation includes the following components.

- Impact Assessment – Characterization of the weatherization network and the households that are income-eligible for WAP. Measurement and monetization of the energy and nonenergy impacts of the program. Assessment of the factors associated with higher levels of energy savings, cost savings, and cost-effectiveness.
- Process Assessment – Direct observation of how the weatherization network delivers services and assessment of how service delivery compares to national standards. Documentation of how weatherization staff and weatherization clients perceive service delivery.
- Special Technical Studies – Examination of the performance of the program with respect to special technical issues such as air sealing, duct sealing, furnace efficiency, and refrigerators.
- Synthesis Study – Synthesis of the findings from this evaluation into a comprehensive assessment of the success of the program in meeting its goals and identification of key areas for program enhancement.

This analysis of the eligible population is part of the Impact Assessment for the program. However, the information developed in this report is applied to all of the study components.

1.2 CHARACTERIZATION OF LOW-INCOME HOUSEHOLDS

As defined for this study, low-income households in the United States are a diverse group of families and individuals with one common characteristic; they all had household income at or below the eligibility threshold set by the WAP regulations for PY 2008. The challenge for this study is to both characterize the

overall population of low-income households in terms of their energy needs and to segment the population into groups of households that are distinct in terms of the way that WAP could best serve them. The study addresses this challenge by documenting the individual dimensions of the population and then looking at how those dimensions might interact in the context of WAP service delivery. The dimensions examined by the analysis include:

- Demographic Characteristics – How do households vary in terms of their household composition, income and sources of income, racial and ethnic groups, and special needs (e.g., age, disability status, and presence of young children)?

- Health Indicators – What is the incidence of health conditions for individuals in low-income households that should be considered by WAP service providers when delivering services?

- Housing Unit Characteristics – How do the housing units that low-income households occupy vary in terms of their housing unit type, age, size, and energy using systems?

- Housing Quality Indicators – What is the incidence of housing quality problems for housing units occupied by low-income households that might be addressed by the WAP?

- Energy Expenditures and Consumption – What is the distribution of energy expenditures and consumption for low-income households?

- Energy Affordability Indicators – What is the incidence of energy affordability problems among low-income households that demonstrate a need for the WAP?

For all of these dimensions, the study assessed whether there were important differences by Climate Zone and Census Region. Figure 1.1 shows how states were assigned to Climates Zones for this study. Figure 1.2 shows how states are assigned to Census Regions.

1.3 ORGANIZATION OF THE REPORT

The report consists of six sections, the remainder of which are:

- Section 2 – Data Sources: Documents the data sources that were used to prepare this report.

- Section 3 – Income-Eligible Households: Furnishes an estimate of the number of households that were income-eligible for WAP in PY 2008 using the CPS ASEC.

- Section 4 – Characteristics of Low-Income Households: Presents information on the characteristics of households, including: characteristics of individuals, structure of households, sources of income, and incidence of health problems. These data show the diversity of WAP-eligible households and the special needs of those households.

- Section 5 – Characteristics of Low-Income Housing Units: Examines the characteristics of housing units that have the most impact on the delivery of weatherization services, including characteristics of the structure (e.g., building type, unit size), energy-using equipment (e.g., space heating equipment, air conditioning equipment), and indicators of housing opportunities and problems.

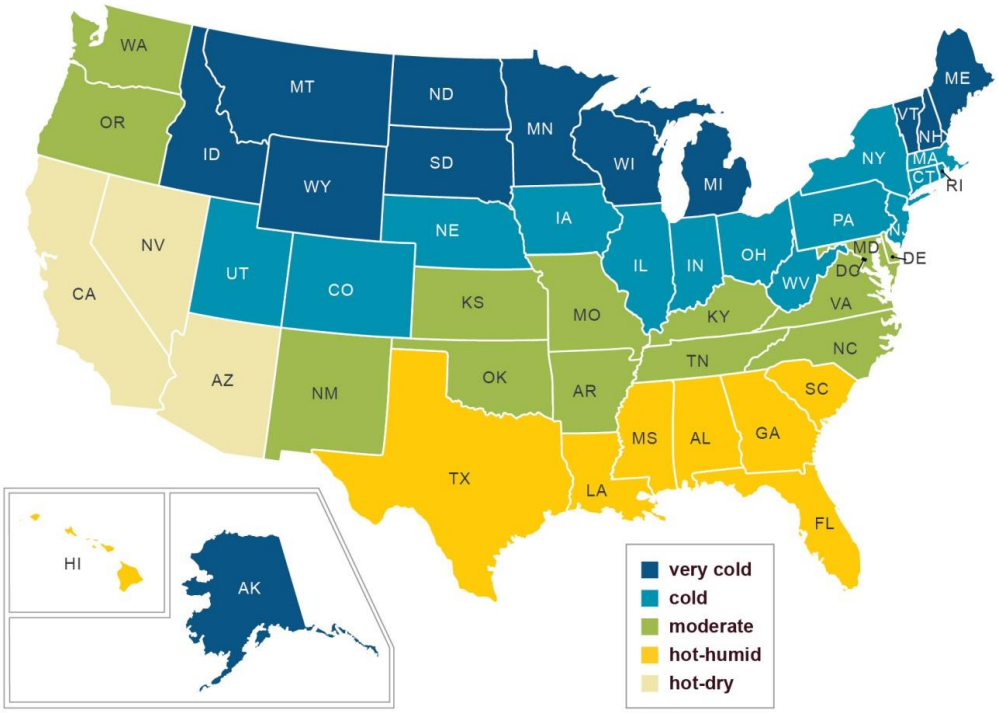

Figure 1.1. Map for the PY 2008 evaluation

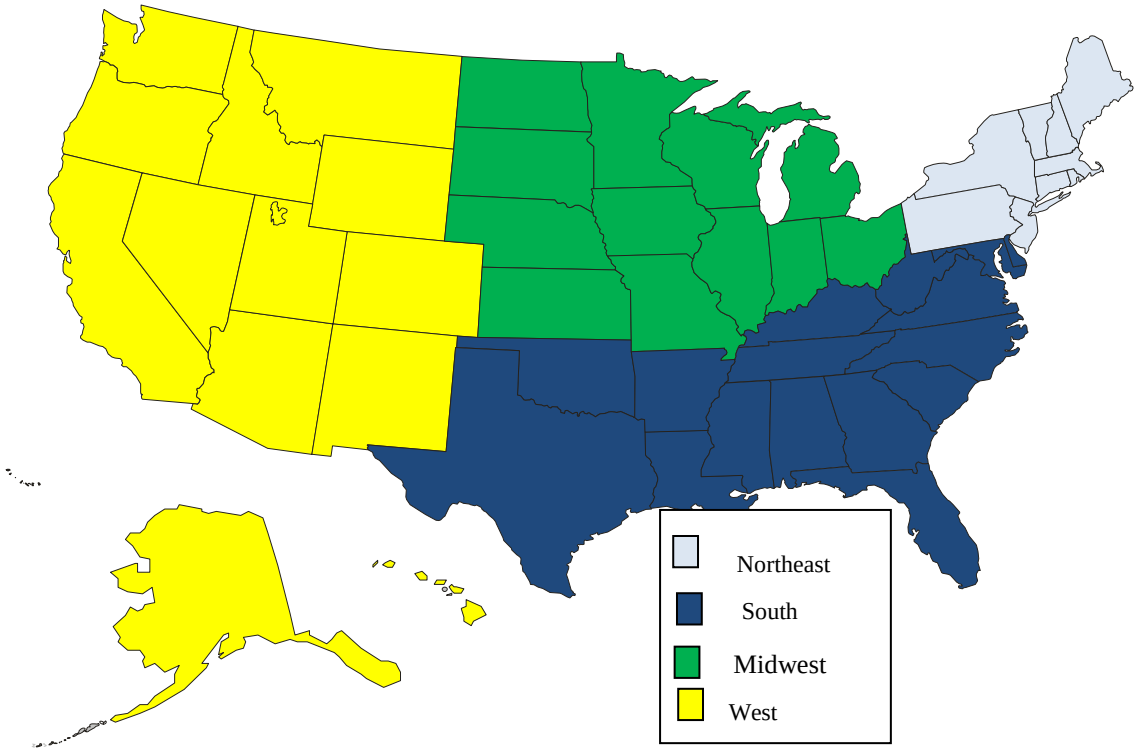

Figure 1.2. Census region map

- Section 6 – Energy Consumption, Expenditures, and Burden: Develops statistics on energy use and how it affects clients. The analysis includes energy affordability indicators and a model for defining high energy usage and high energy burden.

This report is designed to complement other Evaluation Reports and to furnish baseline statistics to support analysis.

2. DATA SOURCES

This section furnishes information on the data sources that are used for the study. All of the data sources are national studies conducted by Federal Statistical Agencies[7] and overseen by the Office of Management and Budget (OMB). Each study has a particular focus which furnishes some important information about low-income households. The set of studies together can be used to develop a more complete picture of the low-income households served by WAP. The studies used in this research are:

- 2005 Residential Energy Consumption Survey (RECS) – Furnishes national and regional estimates of energy consumption and expenditures, as well as information on energy-related characteristics of housing units and energy security for low-income households.

- 2009 Current Population Survey Annual Statistical and Economic Supplement (CPS ASEC) – Furnishes national and regional estimates of the number of low-income households for 2008 and the demographic characteristics of those households.

- 2007 American Housing Survey (AHS) – Furnishes national and regional estimates of housing unit characteristics, the costs of housing, and housing quality for 2007. The survey also can be used to characterize major metropolitan areas.

- 2008 American Community Survey (ACS) – Furnishes state-level and sub-state estimates of the number of low-income households, and their housing unit type, main heating fuel, and energy bill payment patterns.

- 2004 Panel of the Survey of Income and Program Participation (SIPP) – Longitudinal survey that furnishes data on income sources and dynamics for low-income households, as well as adult and child well-being statistics.

- 2008 National Health Interview Survey (NHIS) – Furnishes data on the health status of individuals, including the incidence of health problems and the impacts of health problems on individuals.

All of these studies are conducted on a periodic basis. In all cases, this report used the data from the last study during or prior to WAP PY 2008.

2.1 2005 RESIDENTIAL ENERGY CONSUMPTION SURVEY (RECS)

Energy Information Administration (EIA) administers the RECS to a nationally representative sample of housing units. Specially trained interviewers collect energy characteristics on the housing unit, usage patterns, and household demographics. This information is combined with data from energy suppliers to these homes to estimate energy costs and usage for heating, cooling, appliances and other end uses.

First conducted in 1978, the 2005 RECS was the twelfth survey in the series. The 2005 survey collected data from 4,232 households in housing units statistically selected to represent the 111.1 million housing units that were occupied as a primary residence in 2005. A microdata file (i.e., a file with individual household survey records) was made available for public use by EIA. That is the data file that is used to generate statistics for this report. Data from the 2005 RECS were tabulated for the four Census regions and the five Climate Zones. One advantage of using the RECS is that an indicator of LIHEAP eligibility is included in the data file because the LIHEAP Program Office uses the RECS for reports on low-income

[7]There are 13 statistical agencies in the Federal Government that have statistical activities as their core mission and that conduct much of the government's statistical work.

households. Another advantage of using RECS is that energy data can be cross-tabulated with housing unit and household characteristics data.

The tables in Section 5 of the report use the 2005 RECS statistics directly without adjustment. The RECS was replaced by the 2007 AHS for some tables for two purposes.

1. Climate Zone and Census Region Tables – The sample size for the 2005 RECS is small and the variances for Climate Zone and Census Region statistics are relatively large, particularly for rare population groups. In Section 5, the AHS data was used for those tables.

2. Heating Equipment – DOE is particularly concerned about the use of unvented space heaters. The AHS heating equipment question explicitly asks about unvented heaters. The RECS heating equipment question does not. All heating equipment statistics in Section 5 are developed using AHS data.

The tables in Section 6 of the report use the 2005 RECS adjusted for changes in energy prices and weather between 2005 and 2008. Since weather and prices vary from year to year, the adjusted data file furnishes better information on household status in PY 2008. The data file was not adjusted for other changes in the number of households and the appliance inventory between 2005 and 2008.

2.2 2009 CURRENT POPULATION SURVEY ANNUAL SOCIAL AND ECONOMIC SUPPLEMENT (CPS ASEC)

The CPS ASEC is administered jointly by the Census Bureau and the Bureau of Labor Statistics to a nationally representative sample of housing units. While the CPS is conducted each month to a rotating sample, the ASEC collects additional data in February, March, and April of each year. Trained interviewers collect detailed information about employment status, work experience, income, geographic mobility, and household demographics.

First conducted in 1948, the ASEC is useful because it provides the most timely and accurate national data on income in the previous calendar year, employment, and other economic characteristics. The household, income, and poverty statistics in Section 3 and Section 4 were developed using the 2009 CPS ASEC which reports on household income for 2008.

The 2009 CPS ASEC collected data from 76,134 households in housing units statistically selected to represent the 117.2 million housing units in 2009. Microdata files for the household, family, and person records were made available for public use by the Census. The household and person data files were used to generate statistics for this report.

2.3 2007 AMERICAN HOUSING SURVEY (AHS)

The AHS is sponsored by the U.S. Department of Housing and Urban Development (HUD) to provide comprehensive data about national housing conditions. The Census Bureau conducts the AHS biennially to a nationally representative sample of housing units. Trained interviewers collect detailed data on a variety of housing characteristics, housing quality indicators, and household demographics.

First conducted in 1973, the 2007 AHS was the twenty-second survey in the series. The 2007 survey collected data from 39,107 occupied housing units statistically selected to represent the 110.7 million housing units that were occupied as a primary residence in 2007. Microdata files were made available for public use by HUD. These data files are used to generate statistics for this report.

The 2007 AHS data provides valuable information about housing tenure, specific housing problems, neighborhood quality, and housing costs. Some of the tables in Section 5 of the report use the 2007 AHS statistics.

2.4 2008 AMERICAN COMMUNITY SURVEY (ACS)

The Census Bureau administers the ACS to a representative sample of households in the United States. The ACS is conducted continuously throughout the year using a rolling sample approach. The survey collects national, regional and state-level information on household income, the presence of vulnerable household members, and other demographic and household characteristics.

First fully implemented in 2005, the 2008 ACS is the fourth survey in the series. The 2008 survey collected data from approximately 1.2 million households that were statistically selected to represent the 113.1 million housing units that were occupied as a primary residence in 2008. Data from the 2008 ACS were tabulated for various geographic areas, including the four Census regions, the nine Census divisions, and each state. An annual 1-year estimate microdata file was made available for public use by the Census. This is the data file that is used to generate statistics for this report.

The ACS is useful because the large sample size provides reliable information on a variety of household characteristics. The 2008 ACS was used to develop the primary language and linguistic isolation statistics in Section 4.4. These data also could be used by individual states to develop state level and sub-state estimates of eligible populations.

2.5 2004 SURVEY OF INCOME AND PROGRAM PARTICIPATION (SIPP)

The Census Bureau administers the SIPP to a nationally representative sample of households using a multistage-stratified sample approach.

First conducted in 1983, SIPP is a continuous series of national panels that interview respondents every 4 months over a two to four year period. Interviewers ask respondents about current income, noncash benefits, employment, and participation in government assistance programs.

The 2004 SIPP Adult Well-Being Module collected data from 31,074 individuals. A microdata file was made available for public use by the Census. That is the data file that is used to generate statistics for this report.

SIPP data is useful because it provides in-depth information about the sources of income, the impact of government assistance programs, including energy affordability programs, and demographic characteristics. In addition, the four month recall period allows for more accurate data than annual surveys. The 2004 SIPP data was used in Section 4 of this report.

2.6 2008 NATIONAL HEALTH INTERVIEW SURVEY (NHIS)

The NHIS is a cross-sectional household survey conducted by the Centers for Disease Control and Prevention (CDC). The NHIS is administered continuously throughout the year to a nationally representative sample using a multistage area probability design. Interviewers ask about current health status, chronic and recent health problems, and demographic characteristics. In addition to the primary core questions, a selected sample of adults and children is asked additional detailed questions.

First conducted in 1957, the NHIS provides detailed information about the incidence of various illnesses, limitations caused by health problems, the frequency of doctor visits, and missed work or school days.

The 2008 NHIS data was used in Section 4 to develop statistics for relevant health problems by poverty status.

The 2008 NHIS collected data from 28,790 households statistically selected to represent 102.9 million households. Microdata files for the household, family, person, sample child, and sample adult data were made available for public use by the Census Bureau. Each of these files was used to generate statistics for this report.

3. INCOME-ELIGIBLE HOUSEHOLDS

This section of the report furnishes estimates of the number of households that were income-eligible for WAP in PY 2008 at the national level, by Climate Zone, and by Census Region. Overall, 35.0 million households were income-eligible for WAP (30% of all households). The share of income-eligible households did not vary much by Climate Zone or Census Region.

This section also presents statistics on how many additional households would have been eligible in PY 2008 if either the PY 2010 income eligibility standards or the PY 2012 income eligibility standards had been in place.

- In PY 2010, both the DOE criteria and the LIHEAP criteria were increased making more households income-eligible for WAP. Using those standards, the number of income-eligible households in PY 2008 would have increased to 45.2 million households, representing 39 percent of all households.

- In PY 2012, the DOE criteria remained at the higher level (i.e., 200 percent of poverty), but the LIHEAP criteria returned to the PY 2008 level. Using the PY 2012 standards, 37.2 million households (32 percent of the population) would have been income-eligible for WAP in PY 2008.

Sections 4 through 8 of this report present detailed statistics on the population of households that was income-eligible for WAP in PY 2008. In those sections, the tables include all households that would have been eligible for the program using the highest eligibility standard available to grantees.

3.1 DATA SOURCES AND METHODOLOGY

The statistics in this section of the report were developed using a microdata file from the 2009 Current Population Survey Annual Statistical and Economic Supplement (CPS ASEC). The CPS ASEC survey content focuses on economic and demographic data for individuals, families, and households. Since WAP eligibility standards refer to household income, this analysis uses the household records.

3.2 NATIONAL AND REGIONAL ESTIMATES OF WAP INCOME-ELIGIBLE HOUSEHOLDS

The Federal Government funds a number of different programs that assist households with limited income, including WAP. Each of those programs establishes guidelines that define the maximum income allowable for program participants. For some programs, eligibility is based on the income of an individual (e.g., Supplemental Security Income (SSI)), while for others (including WAP), eligibility is based on the combined income of all household members. Some programs use lower standards than others; the SSI program income threshold is about 75 percent of the poverty line, the Food Stamps program income threshold is about 130 percent of poverty line, and DOE's criteria for WAP was 150 percent of the poverty line for PY 2008. In addition, some programs use gross income (i.e., income before deductions) while others use net income (i.e., income after deductions).

Because the definition of income-eligible varies considerably from program to program, this study defines households that are income-eligible for the PY 2008 WAP program as being "low-income" households. Under the PY 2008 WAP program regulations, states were allowed to set their maximum income eligibility standard using either "the DOE criteria of 150 percent of poverty or the LIHEAP criteria." The LIHEAP criteria for any grantee in FY 2008 was the greater of 150 percent of poverty or 60 percent of state median income. For PY 2008, the LIHEAP criteria made more households eligible for WAP than did the DOE criteria in all states.

This section first provides estimates of the number of households that are income-eligible using the DOE criteria and then provides estimates of the number of households that are income-eligible using the LIHEAP criteria.

3.2.1 Household Counts of Income-Eligible Households – DOE Criteria

For PY 2008 the maximum income using the DOE criteria was 150 percent of poverty. Table 3.1 shows the allowable income by family size for PY 2008. In PY 2008, a one-person household with income at or below $15,600 was income-eligible for WAP, while for a four-person household the income standard was $31,800.

Table 3.1. Income threshold using the DOE criteria for PY 2008 by household size

Household Size	All States excluding Alaska and Hawaii	Alaska	Hawaii
1 household member	$15,600	$19,500	$17,490
2 household members	$21,000	$26,250	$24,150
3 household members	$26,400	$33,000	$30,360
4 household members	$31,800	$39,750	$36,570
5 household members	$37,200	$46,500	$42,780
Each additional person	$5,400	$6,750	$6,210

Source: *Federal Register*, Vol. 73, No.15, January 23, 2008, pp.3971-3972

As discussed in Section 2, the 2009 CPS ASEC was used to develop estimates of income-eligible households for PY 2008. Table 3.2 shows that 24.2 million households had income in 2008 that was at or below 150 percent of poverty. That was about 21% of the 117.2 million households in the United States. Table 3.2 also shows the number and percent of income-eligible households by Climate Zone. The states in the Very Cold Climate Zone had the lowest eligibility rate (18%) and the states in the Hot/Humid Climate Zone had the highest eligibility rate (23%). However, for most parts of the country it would be reasonable to say that about 1 in 5 households were income-eligible for the WAP program in PY 2008 using the DOE criteria.

Table 3.2. Number and percent of income-eligible households (DOE criteria) in PY 2008 by climate zone

Climate Zone	Income-Eligible Households (Millions)	All Households (Millions)	Percent of Households Income-Eligible
Very Cold Climate	2.1	11.7	18%
Cold Climate	7.3	37.5	19%
Moderate Climate	5.1	24.7	21%
Hot/Dry Climate	3.4	16.5	21%
Hot/Humid Climate	6.3	26.9	23%
NATIONAL TOTAL	24.2	117.2	21%

Source: 2009 CPS ASEC

Table 3.3 shows the number of income-eligible households by Census Region. The South Census Region stands out as having a larger number of income-eligible households and a higher percentage of households that were income-eligible for the program in PY 2008.

Table 3.3. Number and percent of income-eligible households (DOE criteria) in PY 2008 by census region

Census Region	Income-Eligible Households (Millions)	All Households (Millions)	Percent of Households Income-Eligible
Northeast	4.1	21.3	19%
Midwest	5.1	26.3	19%
South	9.9	43.4	23%
West	5.1	26.2	20%
NATIONAL TOTAL	24.2	117.2	21%

Source: 2009 CPS ASEC

3.2.2 Household Counts of Income-Eligible Households – LIHEAP Criteria

For PY 2008, the maximum income using the LIHEAP criteria was the greater of 150 percent of poverty and 60 percent of state median income. Table 3.1 shows that the value for 150 percent of poverty is the same in every state except for Alaska and Hawaii. However, since each state has a different median income, the value of the LIHEAP criteria (i.e., 60 percent of state median income) is different for each state. For example, in PY 2008, 60 percent of state median income for a family of four in Arkansas was $31,311, but in Minnesota it was $48,886.

Table 3.4 shows that 35.0 million households had income in CY 2008 that was at or below the LIHEAP criteria for income, about 10 million more households than were eligible using the DOE criteria. That was about 30% of the 117.2 million households in the United States. Table 3.4 also shows the number and percent of income-eligible households by Climate Zone. There was very little difference across Climate Zones in the percent of households that were income-eligible for WAP using the LIHEAP criteria. For most parts of the country it would be reasonable to say that about 3 in 10 households were income-eligible for the WAP program in PY 2008 using the LIHEAP criteria.

Table 3.4. Number and percent of income-eligible households (LIHEAP criteria) in PY 2008 by climate zone

Climate Zone	Income-Eligible Households (Millions)	All Households (Millions)	Percent of Households Income-Eligible
Very Cold Climate	3.4	11.7	29%
Cold Climate	11.5	37.5	31%
Moderate Climate	7.1	24.7	29%
Hot/Dry Climate	5.0	16.5	31%
Hot/Humid Climate	8.0	26.9	30%
NATIONAL TOTAL	35.0	117.2	30%

Source: 2009 CPS ASEC

Table 3.5 shows the number of income-eligible households by Census Region. The South Census Region had the largest number of income-eligible households. But, there was very little difference across Census Regions in the percent of households that were income-eligible for WAP using the LIHEAP criteria.

Table 3.5. Number and percent of income-eligible households (LIHEAP criteria) in PY 2008 by census region

Census Region	Income-Eligible Households (Millions)	All Households (Millions)	Percent of Households Income-Eligible
Northeast	6.8	21.3	32%
Midwest	7.8	26.3	30%
South	12.9	43.4	30%
West	7.5	26.2	29%
NATIONAL TOTAL	35.0	117.2	30%

Source: 2009 CPS ASEC

3.2.3 Comparison of Household Counts – DOE Criteria to LIHEAP Criteria

In PY 2008, the WAP regulations gave states the flexibility to target their resources to households with income at or below 150 percent of poverty, or to expand the population to those households income-eligible for LIHEAP. The tables in this section document the difference in the number of households eligible under those two income standards. Table 3.6 shows that the WAP income-eligible population increased from 24.2 million households to 35.0 million households when the LIHEAP criterion was used, and that the share of the population eligible for WAP increased from about 21 percent to 30 percent.

Table 3.6. Comparison of DOE criteria income-eligible households (150% of poverty) to LIHEAP criteria income-eligible households (greater of 150% of poverty and 60% of median)

Standard	Income-Eligible Households in 2008 (Millions)	Percent of Households Income-Eligible in 2008
PY 2008 WAP Income-Eligible (DOE Criteria)	24.2	21%
FY 2008 LIHEAP Income-Eligible (LIHEAP Criteria)	35.0	30%

Source: 2009 CPS ASEC

Table 3.7 shows how the number of income-eligible households changes for each Climate Zone when the LIHEAP criteria are used. While the number of income-eligible households increases in all Climate Zones, the largest percentage point change is in the Cold Climate Zone (12%) and the smallest percentage point change is in the Hot/Humid Climate Zone (7%).

Table 3.7. Comparison of DOE criteria income-eligible households to LIHEAP criteria income-eligible households by climate zone for PY 2008

Climate Zone	Percent Income-Eligible (DOE Criteria)	Percent Income-Eligible (LIHEAP Criteria)
Very Cold Climate	18%	29%
Cold Climate	19%	31%
Moderate Climate	21%	29%
Hot/Dry Climate	21%	31%
Hot/Humid Climate	23%	30%
NATIONAL	21%	30%

Source: 2009 CPS ASEC

Table 3.8 shows how the number of income-eligible households changes for each Census Region when the LIHEAP criteria are used as the eligibility standard. The number of income-eligible households increases in all Census Regions; the largest change is in the Northeast Census Region (13%) and the smallest change is in the South Census Region (7%).

Table 3.8. Comparison of DOE criteria income-eligible households to LIHEAP criteria income-eligible households by census region for PY 2008

Census Region	Percent Income-Eligible (DOE Criteria)	Percent Income-Eligible (LIHEAP Criteria)
Northeast Region	19%	32%
Midwest Region	19%	30%
South Region	23%	30%
West Region	20%	29%
NATIONAL	21%	30%

Source: 2009 CPS ASEC

The difference between the DOE criteria and the LIHEAP criteria varies considerably by state. For example, for PY 2008, the number of households income-eligible for WAP in Mississippi was about 330,000 using the DOE criteria and increased slightly to 339,000 using the LIHEAP criteria. By comparison, the number of households income-eligible for WAP in Illinois was about 863,000 using the DOE criteria, but increased substantially to 1,507,000 using the LIHEAP criteria. For states with a high median income there is a larger difference between the number of eligible households when using the DOE criteria compared to the number of eligible households when using the LIHEAP criteria.

3.3 PY 2008 INCOME CRITERIA COMPARED TO PY 2010 INCOME CRITERIA

There were important differences between the PY 2008 income eligibility criteria and the PY 2010 income eligibility criteria. First, the DOE criterion was changed from 150 percent of poverty to 200 percent of poverty. Second, the LIHEAP criterion was changed from 60 percent of state median income to 75 percent of state median income. In PY 2010, program regulations allowed States to set their maximum income standard using either the DOE criteria or the LIHEAP criteria. However, unlike PY 2008, in PY 2010, the DOE criterion was sometimes greater than the LIHEAP criterion; for a family of four in PY 2010, the DOE criterion was higher for 5 grantees, and the LIHEAP criterion was higher for 46 grantees.

Table 3.9 compares the number of households that were income-eligible in PY 2008 with the number that would have been income-eligible in PY 2008 if the higher income thresholds had been in place at that time. It shows that the number of households potentially eligible for WAP would have increased from 35.0 million to 45.2 million (39% of the population).[8]

[8]In PY 2010, 50.7 million households were eligible for WAP. The increase in the number of low-income households was a result of the growth in the number of households from 117.2 million to 118.7 million, coupled with an increase in the percentage of households that were low-income from 39% to 43% because of the economic downturn.

Table 3.9. Comparison of PY 2008 income-eligible households using PY 2008 LIHEAP criteria with PY 2010 WAP criteria

Standard	Income-Eligible Households in 2008 (Millions)	Percent of Households Income-Eligible in 2008
PY 2008 Income-Eligible(LIHEAP Criteria)	35.0	30%
PY 2010 WAP Standard (Greater of 200% of Poverty and 75% of State Median)	45.2	39%

Source: 2009 CPS ASEC

Table 3.10 shows the difference in the number of income-eligible households by Climate Zone. For all of the Climate Zones, the percentage of income-eligible households increased by 8 to 9 percentage points.

Table 3.10. Comparison of PY 2008 income-eligible households using PY 2008 LIHEAP criteria with PY 2010 WAP criteria by climate zone

Climate Zone	Percent WAP Income-Eligible PY 2008 Standard	Percent WAP Income-Eligible PY 2010 Standard
Very Cold Climate	29%	38%
Cold Climate	31%	40%
Moderate Climate	29%	37%
Hot/Dry Climate	31%	39%
Hot/Humid Climate	30%	38%
NATIONAL	30%	39%

Source: 2009 CPS ASEC

Table 3.11 shows the difference in the number of income-eligible households by Census Region. For all of the Census Regions, the percentage of income-eligible households increased by 8 to 9 percentage points.

Table 3.11. Comparison of PY 2008 income-eligible households using PY 2008 LIHEAP criteria with PY 2010 WAP criteria by census region

Census Region	Percent WAP Income-Eligible PY 2008 Standard	Percent WAP Income-Eligible PY 2010 Standard
Northeast Region	32%	41%
Midwest Region	30%	39%
South Region	30%	38%
West Region	29%	37%
NATIONAL	30%	39%

Source: 2009 CPS ASEC

3.4 PY 2008 INCOME CRITERIA COMPARED TO PY 2012 INCOME CRITERIA

In PY 2012, the DOE criteria for WAP eligibility was unchanged from the PY 2010 criteria. However, the LIHEAP criterion was reduced from 75 percent of state median income to 60 percent of state median income. Because the LIHEAP criteria was reduced, the number of households eligible for WAP was lower using the PY 2012 standard than it was using the PY 2010 standard. In PY 2012 the DOE criterion was higher for 31 grantees and the LIHEAP criterion was higher for 20 grantees.

Table 3.12 compares the number of households that were income-eligible in PY 2008 with the number that would have been income-eligible in PY 2008 if the higher income thresholds had been in place at that time. It shows that the number of households potentially eligible for WAP would have increased from 35.0 million to 37.2 million (32% of the population). Overall, the difference between the PY 2008 guideline and the PY 2012 guideline increases the eligible population by about 2 million households and 2 percentage points.

Table 3.12. Comparison of PY 2008 income-eligible households using PY 2008 LIHEAP criteria with PY 2012 WAP criteria

Standard	Income-Eligible Households in 2008 (Millions)	Percent of Households Income-Eligible in 2008
PY 2008 Income-Eligible (Greater of 150% of Poverty and 60% of State Median)	35.0	30%
PY 2012 WAP Standard (Greater of 200% of Poverty and 60% of State Median)	37.2	32%

Source: 2009 CPS ASEC

Table 3.13 shows the difference in the number of income-eligible households by Climate Zone. The Hot/Humid Climate Zone would have experienced the largest increase in the number of income-eligible households if the PY 2012 income standards had been in place in PY 2008. In that zone, the share of households that were income-eligible for WAP would have increased by 4 percentage points if the 2012 income standard were used.

Table 3.13. Comparison of PY 2008 income-eligible households using PY 2008 LIHEAP criteria with PY 0000 WAP criteria by climate zone

Climate Zone	Percent WAP Income-Eligible PY 2008 Standard	Percent WAP Income-Eligible PY 2012 Standard
Very Cold Climate	29%	30%
Cold Climate	31%	31%
Moderate Climate	29%	32%
Hot/Dry Climate	31%	31%
Hot/Humid Climate	30%	34%
NATIONAL	30%	32%

Source: 2009 CPS ASEC

Table 3.14 shows the difference in the number of Income-Eligible households by Census Region. The South Census Region would have experienced the largest increase in the percentage of households that were income-eligible if the higher income standards had been in place in PY 2008. In that Census Region the share of households that were income-eligible for WAP increased by 4 percentage points using the 2012 income standard.

Table 3.14. Comparison of PY 2008 income-eligible households using PY 2008 LIHEAP criteria with PY 2010 WAP criteria by census region

Census Region	Percent WAP Income-Eligible PY 2008 Standard	Percent WAP Income-Eligible PY 2012 Standard
Northeast Region	32%	32%
Midwest Region	30%	30%
South Region	30%	34%
West Region	29%	30%
NATIONAL	30%	32%

Source: 2009 CPS ASEC

4. CHARACTERISTICS OF LOW-INCOME HOUSEHOLDS

This section of the report furnishes information on the characteristics of households that were income-eligible for WAP in PY 2008 (i.e., low-income). It examines four different dimensions of the population.

- Characteristics of Households and Household Members – The first part of this section presents information on households and household members, including the presence of vulnerable members (i.e., elderly, disabled members, and children), the household structure, and the number of household members.

- Income and Income Sources – The second part of this section presents information on income and poverty level, and income sources for low-income households.

- Race, Ethnicity, and Language – The third part of this section presents information on the race and ethnicity of low-income households, as well the incidence of linguistic isolation among these households.

- Health Issues – The last part of this section presents information about the incidence of health issues for individuals in low-income households, including: asthma and other respiratory problems, diabetes and other circulatory problems, and the number of days of school and worked missed due to illness.

The tables in this section of the report show that low-income households are diverse, and that no one type of household is dominant. However, there are large segments within the population of low-income households that can be expected to have different service needs. In addition, there are some regional differences that also are relevant to the delivery of WAP program services.

4.1 DATA SOURCES AND METHODOLOGY

The statistics in Section 4.2 and 4.3, and most of the statistics in Section 4.4 were developed using microdata from the 2009 CPS ACEC. The CPS ASEC survey content focuses on economic and demographic data for individuals, families, and households. Since WAP eligibility standards refer to household income and demographics, this analysis uses the household records. In addition, since WAP gives priority to households that include vulnerable individuals, the CPS ASEC person records also are used.

The primary language and linguistic isolation statistics in Section 4.4 were developed using microdata from the 2008 ACS.

The health indicators in Section 4.5 were developed using microdata from the 2007 SIPP and the 2008 NHIS.

4.2 CHARACTERISTICS OF HOUSEHOLDS AND HOUSEHOLD MEMBERS

DOE regulations require grantees to give priority to households with vulnerable members, including households with elderly, disabled, and children. The DOE regulations allow each grantee to develop definitions for each type of individual. Table 4.1 presents statistics on the share of low-income households that have one or more vulnerable individuals.

- Elderly[9] – 14.0 million low-income households had at least one individual who is 60 or older (40 percent of the low-income population) and 6.9 million households had at least one individual who is 75 or older.

- Disabled[10] – 9.6 million low-income households had at least one disabled individual. About one-third of disabled individuals also were elderly.

- Children – 13.3 million low-income households had a child who was 18 or younger (38 percent of low-income households). LIHEAP targets young children (less than 6); 6.7 million low-income households had a young child.

In PY 2008, 84 percent of the low-income households had a vulnerable household member: an elderly individual, a disabled individual, or a child. WAP requires states to target households with vulnerable individuals. In addition, states can, at their discretion, prioritize households with high energy usage or high energy burden.

Table 4.1. Number and percent of low-income households by target demographic group in PY 2008

Target Group	Low-Income Households (Millions)	Percent of Low-Income Households
Elderly Households (60+)	14.0	40%
Elderly Households (75+)	6.9	20%
Disabled Households	9.6	27%
Disabled Elderly	3.2	9%
Disabled Adult Non-Elderly	6.4	18%
Disabled Child	0.5	1%
Households with Children	13.3	38%
Households with Children <=5	6.7	19%
No Vulnerable Members	5.7	16%
NATIONAL TOTAL	35.0	100%

Source: 2009 CPS ASEC

Across all household groups, 30 percent of households were low-income. The percentage varies considerably by group. Table 4.2 shows that about half of all disabled households and 36 percent of elderly households were low-income. Only 16 percent of households that did not have vulnerable members were low-income.

[9]The LIHEAP program targets households with individuals who are 60 or older. However, since households with an individual 75 or older are more likely to have chronic health problems, statistics for this group are also presented.

[10]A person with a disability is defined as anyone 15 years or older who had limited work opportunities during the preceding year due to a disability, as reported on the CPS ASEC. The definition also includes individuals who received Veteran's Disability income or Social Security Disability income for themselves or for a surviving, dependent, or disabled child, as well as individuals under age 65 who received Supplemental Security Income or Medicare benefits in the preceding year.

Table 4.2. Number and percent of targeted households that are low-income in PY 2008

Target Group	Low-Income Households (Millions)	All Households (Millions)	Percent Low-Income
Elderly Households	14.0	38.7	36%
Frail Elderly (75+)	6.9	14.5	48%
Disabled Households	9.6	19.2	50%
Disabled Elderly	3.2	6.7	48%
Disabled Adult Non-Elderly	6.4	12.5	51%
Disabled Child	0.5	0.8	59%
Households with Children	13.3	41.3	32%
Households with Children <=5	6.7	17.8	38%
No Vulnerable Members	5.7	34.6	16%
NATIONAL TOTAL	35.0	117.2	30%

Source: 2009 CPS ASEC

Table 4.3 shows that in all Climate Zones 82 to 85 percent of households have vulnerable members. The Hot/Dry Climate Zone differs most from the others: having fewer elderly and disabled households, and more households with children.

Table 4.3. Demographic target groups as a percent of the low-income population in PY 2008 by climate zone

Climate Zone	Percent Elderly Households	Percent Disabled Households	Percent Households with Children	Percent of Households with Vulnerable Members
Very Cold Climate	40%	26%	34%	82%
Cold Climate	42%	27%	37%	85%
Moderate Climate	40%	30%	37%	84%
Hot/Dry Climate	35%	23%	44%	82%
Hot/Humid Climate	40%	29%	40%	85%
NATIONAL	40%	27%	38%	84%

Source: 2009 CPS ASEC

Table 4.4 shows that in all Census Regions 82 to 85 percent of households have vulnerable members. The Northeast Census Region has more elderly households than other Regions, while the West Region has more households with children.

Table 4.4. Demographic target groups as a percent of the low-income population in PY 2008 by census region

Census Region	Percent Elderly Households	Percent Disabled Households	Percent with Children	Percent Targeted Households
Northeast	45%	28%	35%	85%
Midwest	39%	27%	37%	83%
South	41%	30%	38%	85%
West	36%	23%	42%	82%
NATIONAL	40%	27%	38%	84%

Source: 2009 CPS ASEC

Tables 4.5 and 4.6 furnish detailed analysis of the types of households that are low-income. Elderly individuals can live in homes by themselves or with other family members. Households with children can have two parents or only one parent in the home. Table 4.5 shows that 23 percent of low-income households consist of an elderly individual living alone, and Table 4.6 shows that more than half of these households are low-income for WAP. Similarly, Table 4.5 shows that 13 percent of low-income households consist of a single parent family, and Table 4.6 shows that over 60 percent of single parent households are low-income.

Table 4.5. Number and percent of low-income households by household type in PY 2008

Household Type	Number of Low Income Households (Millions)	Percent of Low Income Households
Households with Children	**13.2**	**38%**
Two Parents + Children Only	4.7	13%
One Parent + Children Only	4.5	13%
Other Households with Children	4.0	11%
Households with Elderly	**14.0**	**40%**
Elderly Individual	8.0	23%
Elderly Couple	3.2	9%
Other Households with Elderly	2.8	8%
Other Households	**8.9**	**25%**
Non-Elderly Individual	5.6	16%
Non-Elderly Couple	1.2	3%
Non-Elderly Adults (2+)	2.1	6%
NATIONAL TOTAL*	**35.0**	**100%**

* This adds up to 36.1 million and 103% because 3% of households have both an elderly person and a child.

Source: 2009 CPS ASEC

Table 4.6. Number and percent of households that are low-income by household type in PY 2008

Household Type	Low Income Households (Millions)	All Households (in Millions)	Percent Low-Income
Households with Children	**13.2**	**41.1**	**32%**
Two Parents + Children Only	4.7	22.2	21%
One Parent + Children Only	4.5	7.3	62%
Other Households with Children	4.0	11.6	34%
Households with Elderly	**14.0**	**38.7**	**36%**
Elderly Individual	8.0	14.3	56%
Elderly Couple	3.2	14.3	22%
Other Households with Elderly	2.8	10.1	28%
Other Households	**8.9**	**40.8**	**22%**
Non-Elderly Individual	5.6	17.4	32%
Non-Elderly Couple	1.2	11.6	10%
Non-Elderly Adults (2+)	2.1	11.8	18%
NATIONAL TOTAL*	**35.0**	**117.2**	**30%**

This adds up to 36.1 million and 120.6 million, respectively, because there are households that have both elderly people and children.

Source: 2009 CPS ASEC

Tables 4.7 and 4.8 present a slightly different way of looking at household structure. Table 4-7 shows the number and percent of low-income households by the number of household members. Almost 40 percent of low-income households are single-person households. Only about 12 percent of low-income households have five or more people in the household. Table 4-8 shows the percentage of households in each size group that are low-income for WAP. The table shows that households with one person have the greatest incidence of being low-income (43 percent) and households with five or more people also have a greater chance of being low-income than other types of households (36 percent).

Table 4.7. Number and percent of low-income households by household size in PY 2008

Household Type	Number of Low-Income Households (Millions)	Percent of Low-Income Households
One Person	13.6	39%
Two People	8.6	25%
Three People	4.7	13%
Four People	3.9	11%
Five People or More	4.2	12%
NATIONAL TOTAL	35.0	100%

Source: 2009 CPS ASEC

Table 4.8. Number and percent of households that are low-income for WAP by household size in PY 2008

Household Type	Low-Income Households (Millions)	All Households (Millions)	Percent Low-Income
One Person	13.6	31.7	43%
Two People	8.6	39.2	22%
Three People	4.7	18.6	25%
Four People	3.9	16.1	24%
Five People or More	4.2	11.6	36%
NATIONAL TOTAL	35.0	117.2	30%

Source: 2009 CPS ASEC

4.3 POVERTY, INCOME, AND INCOME SOURCES

Households with income at or below 60 percent of state median income were income-eligible for WAP in PY 2008 (i.e., low-income). Within the population of low-income households there is a wide range of economic circumstances in terms of the amount of income available to the household, the number of household members whose needs must be met with the available income, and the sources of income. Table 4.9 shows how households were distributed in terms of their percent of poverty in PY 2008. Almost 30 percent of all households had gross income below 200 percent of the poverty guideline, and about 11 percent of households had gross income below the poverty guideline.

Table 4.9. Number and percent of households by poverty group in PY 2008

Poverty Group	Households (Millions)	Percent of Households
Less than 100% of Poverty	13.2	11%
100% to Less Than 150% of Poverty	10.9	9%
150% to Less Than 200% of Poverty	10.9	9%
200% of Poverty or More	82.2	70%
NATIONAL TOTAL	117.2	100%

Source: 2009 CPS ASEC

Table 4.10 shows the poverty distribution for low-income households. In PY 2008, all households with incomes at or below 150 percent of the poverty guideline were low-income for WAP. Households with income at or below 150 percent of poverty represented almost 70 percent of low-income households. In PY 2008, about 25 percent of low-income households had income between 150 percent of poverty and 200 percent of poverty.

Table 4.10. Number and percent of low-income households by poverty group in PY 2008

Poverty Group	Households (Millions)	Percent of Households
Less than 100% of Poverty	13.2	38%
100% to Less Than 150% of Poverty	10.9	31%
150% to Less Than 200% of Poverty	8.7	25%
200% of Poverty or More	2.2	6%
NATIONAL TOTAL	35.0	100%

Source: 2009 CPS ASEC

Table 4.11 shows the poverty distribution for low-income households by Climate Zone. In the Hot/Humid Climate Zone, households with income less than the poverty guideline make up a larger share of low-income households than in other Climate Zones.

Table 4.11. Percent of low-income households by poverty group in PY 2008 by climate zone

Climate Zone	Less than 100% of Poverty	100% to Less Than 150% of Poverty	150% to Less Than 200% of Poverty	200% of Poverty or More	All Low-Income Households
Very Cold Climate	33%	29%	28%	10%	100%
Cold Climate	35%	28%	27%	10%	100%
Moderate Climate	38%	33%	23%	5%	100%
Hot/Dry Climate	38%	30%	26%	6%	100%
Hot/Humid Climate	44%	35%	21%	<1%	100%
NATIONAL	38%	31%	25%	6%	100%

Source: 2009 CPS ASEC

Table 4.12 shows the poverty distribution for low-income households by Census Region. In the South Region, households with income less than the poverty guideline make up a larger share of low-income households than in other Census Regions.

Table 4.12. Percent of low-income households by poverty group in PY 2008 by census region

Census Region	Less than 100% of Poverty	100% to Less Than 150% of Poverty	150% to Less Than 200% of Poverty	200% of Poverty or More	All Households
Northeast	34%	26%	26%	14%	100%
Midwest	35%	30%	29%	6%	100%
South	42%	34%	21%	2%	100%
West	37%	31%	26%	6%	100%
NATIONAL	38%	31%	25%	6%	100%

Source: 2009 CPS ASEC

Table 4.13 shows the gross income reported by households that were low-income for WAP in PY 2008. One fourth of low-income households have annual household income of less than $10,000. The median income for low-income households was $16,842. About one in seven low-income households had gross income of $30,000 or more.

Table 4.13. Number and percent of low-income households (LIHEAP criteria) by income group in PY 2008

Income Group	Households (Millions)	Percent of Households Low-Income
Less than $10,000	8.4	24%
$10,000 to Less than $20,000	13.3	38%
$20,000 to Less than $30,000	8.3	24%
$30,000 or More	5.0	14%
NATIONAL TOTAL	35.0	100%

Source: 2009 CPS ASEC

It is important to understand that income as reported in the CPS ASEC survey is an imperfect indicator of the well-being of a household. The reported income includes all cash sources of income, but does not ask households to estimate the value of noncash benefits such as subsidized housing and food stamps. In addition, the gross income reported by households does not account for differences in work expenses such as commuting and childcare, or expenses for medical care and prescriptions.

Looking at the sources of income for low-income households furnishes another indicator of the diversity of these households. Table 4-14 shows the number and percent of households that receive each of the different sources of income.

- Wages – Over half of low-income households received wages during PY 2008.
- Retirement Income – About four in ten households received retirement income, including either pensions or Social Security.
- Public Assistance – Only about one in ten low-income households received cash public assistance, including Temporary Assistance for Needy Families (TANF) payments, SSI, or other public assistance.
- Other Income – About four in ten households reported other sources of income (e.g., unemployment insurance, Social Security disability income, and Veteran's benefits.)

Table 4-15 shows that the primary source of income for most low-income households was either wages or retirement benefits. About 47 percent of households reported more income in wages than from any other source, and about 36 percent of households reported more income from retirement benefits than any other source. Only 6 percent of low-income households reported that public assistance benefits made up the majority of their income during PY 2008.

Table 4.14. Number and percent of low-income households with income source in PY 2008

Households with Income Source	Households (Millions)	Percent of Low-Income Households
Wages	19.1	54%
Retirement	14.2	41%
Public Assistance	4.5	13%
Other Sources	14.8	42%

Source: 2009 CPS ASEC

Table 4.15. Number and percent of low-income households by primary income source in PY 2008

Primary Income Source	Households (Millions)	Percent of Low-Income Households
Wages	16.4	47%
Retirement	12.7	36%
Public Assistance	2.1	6%
Other Sources	3.9	11%
NATIONAL TOTAL	35.0	100%

Source: 2009 CPS ASEC

Tables 4-16 and 4-17 show the primary sources of income by Climate Zone and Census Region. The Hot/Dry Climate Zone stands out as having the largest percentage of households with wages as their primary source of income, and the Very Cold Climate Zone stands out as having the largest percentage of households with retirement income as their primary source of income. Similarly, the West Census Region has the highest share of households with wage income and the Northeast Census Region has the highest share of households with retirement income.

Table 4 16. Percent of low-income households by primary income source in PY 2008 by climate zone

Climate Zone	Wages	Retirement	Public Assistance	Other Sources	All Low-Income Households
Very Cold Climate	45%	40%	5%	10%	100%
Cold Climate	45%	38%	7%	10%	100%
Moderate Climate	46%	38%	5%	10%	100%
Hot/Dry Climate	54%	27%	6%	13%	100%
Hot/Humid Climate	47%	36%	5%	12%	100%
NATIONAL	47%	36%	6%	11%	100%

Source: 2009 CPS ASEC

Table 4.17. Percent of low-income households by primary income source in PY 2008 by census region

Census Region	Wages	Retirement	Public Assistance	Other Sources	All Low-Income Households
Northeast	43%	40%	8%	9%	100%
Midwest	46%	38%	5%	11%	100%
South	46%	37%	5%	12%	100%
West	53%	29%	6%	12%	100%
NATIONAL	47%	36%	6%	11%	100%

Source: 2009 CPS ASEC

The primary source of income varies considerably by the type of household (Table 4-18a). For low-income elderly households, almost 80 percent indicate that retirement benefits are their primary source of income. Wages are the primary source of income for almost 80 percent of households with children and households with no vulnerable members. Households with disabled household members are the most diverse, with about one in four having wages as their primary source of income, and one in five relying on public assistance benefits as their primary source of income.

Table 4.18a. Percent of households by primary income source in PY 2008 by target group

Target Group	Wages	Retirement	Public Assistance	Other Sources	All Low-Income Households
Elderly Households	12%	78%	4%	6%	100%
Disabled Households	24%	46%	18%	12%	100%
Households with Children	77%	7%	6%	10%	100%
Non-Vulnerable	77%	2%	<1%	21%	100%
ALL LOW-INCOME	47%	36%	6%	11%	100%

Source: 2009 CPS ASEC

The primary source of income also varies considerably by poverty level. At all poverty levels, the plurality of households had wages as their primary source of income in PY 2008. However, households with income below the poverty line had the lowest percentage of households with wages as their primary source of income (38 percent), the highest percentage of households with public assistance as their primary source of income (12 percent), and the highest percentage of households with other sources of income as their primary source (23 percent). Households in the 100 percent to 150 percent of poverty had the highest percentage of households with retirement as their primary source of income. Households with incomes greater than 200 percent of poverty had the highest percentage of households with wages as their primary source of income.

Table 4.18b. Percent of households by primary income source in PY 2008 by poverty level

Poverty Level	Wages	Retirement	Public Assistance	Other Sources	All Households
Less than 100%	38%	27%	12%	23%	100%
100% to Less than 150%	47%	45%	3%	4%	100%
150% to Less than 200%	58%	38%	1%	4%	100%
200% or More	83%	14%	<1%	3%	100%
NATIONAL TOTAL	72%	21%	2%	6%	100%

Source: 2009 CPS ASEC

4.4 RACE, ETHNICITY, AND LINGUISTIC ISOLATION

Households that were low-income in PY 2008 represented all racial and ethnic groups. Table 4.19 shows that over half (56 percent) of low-income households had a head of household who was white non-Hispanic. Black non-Hispanic households and Hispanic households each represented about one in six households. Other racial and ethnic groups represented about 10 percent of low-income households.

Table 4.19. Number and percent of low-income households by racial/ethnic group in PY 2008

Racial/Ethnicity Group	Households (Millions)	Percent of Households
While Non-Hispanic	19.6	56%
Black Non-Hispanic	6.0	17%
Hispanic	5.8	16%
Asian/Pacific Islander	1.2	4%
Native American	0.2	1%
Other/More than One Group	2.1	6%
NATIONAL TOTAL	35.0	100%

Source: 2009 CPS ASEC

Tables 4.20 and 4.21 show the distribution of race and ethnicity by Climate Zone and Census Region. The Very Cold Climate Zone has the highest percentage of white non-Hispanic households, while the Hot/Dry and Hot/Humid Climate Zones have the highest proportions of Hispanic households. The Hot/Humid Climate Zone has the highest percentage of black non-Hispanic households. The Midwest Census Region has the highest percentage of white non-Hispanic households, the West Census Region has the highest percentage of Hispanic households, and the South Census Region has the highest percentage of black non-Hispanic households. However, all Climate Zones and Census Regions have a diverse population of low-income households.

Table 4.20. Percent of low-income households by racial/ethnic group in PY 2008 by climate zone

Climate Zone	White Non-Hispanic	Black Non-Hispanic	Hispanic	Asian/Pacific Islander	Native American	Other	All Low-Income Households
Very Cold Climate	75%	12%	4%	1%	2%	5%	100%
Cold Climate	63%	15%	13%	3%	<1%	5%	100%
Moderate Climate	63%	19%	7%	2%	2%	7%	100%
Hot/Dry Climate	37%	8%	39%	8%	1%	7%	100%
Hot/Humid Climate	44%	27%	21%	3%	<1%	5%	100%
NATIONAL	56%	17%	16%	4%	1%	6%	100%

Source: 2009 CPS ASEC

Table 4.21. Percent of low-income households by racial/ethnic group in PY 2008 by census region

Census Region	White Non-Hispanic	Black Non-Hispanic	Hispanic	Asian/Pacific Islander	Native American	Other	All Low-Income Households
Northeast	60%	15%	15%	4%	<1%	5%	100%
Midwest	71%	15%	6%	2%	1%	6%	100%
South	52%	26%	15%	2%	1%	5%	100%
West	45%	7%	31%	8%	1%	8%	100%
NATIONAL	56%	17%	16%	4%	1%	6%	100%

Source: 2009 CPS ASEC

It is important for there to be effective communication between WAP clients and WAP service delivery staff. The Census collects data on the primary language of the head of household, and collects information on whether at least one person 16 years or older in the household can speak English "well or very well." If the primary language for a household is not English, and no individual in the household can speak English "well or very well," the household is characterized as linguistically isolated. Table 4-22 shows that about 25 percent of low-income households have a primary language that is not English. Of those, 17 percent speak Spanish as their primary language and 8 percent speak another language. The data also show that about 10 percent of households are linguistically isolated, 7 percent speak Spanish and 3 percent speak some other language.

Tables 4-23 and 4-24 show that linguistic isolation varies considerably by Climate Zone and Census Region. In the Very Cold Climate Zone only about 3 percent of households are linguistically isolated, while in the Hot/Dry Climate Zone over 20 percent of households are linguistically isolated. In the Northeast Census Region, about three in ten households have a primary language other than English, with about 15 percent of households having Spanish as a primary language and about 13 percent having another language as the primary language. In the South Census Region, 16 percent of households have Spanish as the primary language, but only 4 percent of households have another primary language. In the

West Census Region over 40 percent of households have a primary language other than English and 30 percent of households have Spanish as their primary language.

Table 4.22. Number and percent of low-income households by primary language and linguistic isolation group in PY 2008

Primary Language / Linguistic Isolation Group	Households (Millions)	Percent of Households
English	23.8	75%
Spanish – Not Isolated	3.1	10%
Spanish – Isolated	2.1	7%
Other – Not Isolated	1.7	5%
Other – Isolated	1.0	3%
NATIONAL TOTAL	31.7	100%

Source: 2008 ACS

Table 4.23. Percent of low-income households by linguistic isolation group in PY 2008 by climate zone

Climate Zone	English	Spanish – Not Isolated	Spanish – Isolated	Other – Not Isolated	Other - Isolated	All Low-Income Households
Very Cold Climate	88%	3%	1%	5%	2%	100%
Cold Climate	76%	8%	5%	6%	4%	100%
Moderate Climate	87%	5%	3%	3%	2%	100%
Hot/Dry Climate	50%	22%	15%	8%	6%	100%
Hot/Humid Climate	72%	12%	10%	4%	2%	100%
NATIONAL	75%	10%	7%	5%	3%	100%

Source: 2008 ACS

Table 4.24. Percent of low-income households by primary language and linguistic isolation group in PY 2008 by census region

Census Region	English	Spanish – Not Isolated	Spanish – Isolated	Other – Not Isolated	Other - Isolated	All Low-Income Households
Northeast	71%	9%	6%	8%	5%	100%
Midwest	87%	4%	3%	4%	2%	100%
South	79%	9%	7%	3%	1%	100%
West	59%	17%	11%	7%	5%	100%
NATIONAL	75%	10%	7%	5%	3%	100%

Source: 2008 ACS

4.5 HEALTH-RELATED ISSUES FOR WAP LOW-INCOME HOUSEHOLDS

The delivery of weatherization services has the potential to mitigate health problems that are faced by households[11], such as:

- Asthma and Other Respiratory Problems – For individuals with asthma or other respiratory problems, the delivery of WAP services can improve the indoor air quality and potentially reduce irritants that can exacerbate symptoms by reducing moisture in the home that can facilitate the growth of mold and by reducing the infiltration of pollens and dust from outside the home.[12]

- Diabetes and Other Circulatory Problems – Individuals with diabetes and other circulatory problems have a difficult time regulating their body temperature. WAP services can improve the distribution of heating and cooling in the home and reduce drafts, thereby helping such individuals to maintain a consistent body temperature and reduce the occurrence of medical conditions associated with thermal stress on the body.

- Other Illness – When a home is too hot or too cold, or when the indoor air quality is poor, it can have a detrimental impact on the health of individuals, causing adults to miss days of work and children to miss days of school. By helping to improve the indoor air quality and give the household the ability to maintain a safe and healthy temperature in the home, WAP can improve the health and productivity of individuals in the home.

The SIPP has good information on the economic status of households. It also collects general information about the well-being of households in special modules that are conducted periodically. A review of the data from the 2004 SIPP Panel that collected data in its 2005 Adult Well-Being Module furnished the following information about the health status of low-income households compared to households that are not low-income.

- Self-Reported Health Status – In 28 percent of low-income households, the reference adult reported that his/her health was either fair or poor. In households that are not income-eligible for WAP, only about 11 percent of the households had a reference adult reporting fair or poor health status.

- Nights in the Hospital – About 16 percent of reference adults in low-income households spent one or more nights in the hospital during the year, compared to only about 10 percent of the reference adults in households that were not low-income.

- Days Sick in Bed – About 72 percent of reference adults in low-income households reported spending one or more days sick in bed compared to 64 percent of adults in households that were not low-income. The average number of sick days was 28 days for low-income households and 12 days for households that were not low-income.

The 2008 NHIS furnishes more detailed information about the incidence of specific illnesses and also furnishes important information about days of work and school missed. Tables 4.25 and 4.26 furnish information on the incidence of respiratory problems in adults and children respectively. Overall, the incidence of respiratory problems among adults is slightly higher for low-income households than for

[11] ORNL conducted an analysis and monetization of health and household benefits attributable to WAP as part of the WAP evaluation. For more information on the non-energy, or co-benefits, of WAP refer to: Tonn, B., Rose, E., Hawkins, B., and Conlon, B. 2014b. Health and Household-Related Benefits Attributable to the Weatherization Assistance Program. ORNL/TM-2014/345, Oak Ridge National Laboratory, Oak Ridge, Tennessee, September.

[12] However, if there are indoor sources of irritants (e.g., smoke), air sealing and reducing the number of air changes per hour could exacerbate the problem.

households that are not low-income. Similarly, the rate of respiratory problems is 23.4 percent for children in low-income households compared to 21.3 percent for children in households that are not low-income. However, in households that have children, almost twice as many children in low-income households have asthma compared to children in households that are not low-income (13.2 percent vs. 7.7 percent). Overall, about 3.9 percent of low-income households have children with asthma.

Table 4.25. Percent of low-income and non-low-income households with an adult who has respiratory problems in PY 2008

Income Group	Percent with Asthma	Percent with Hay Fever	Percent with Sinusitis	Percent with Chronic Bronchitis	Any Respiratory Problem
Low-Income	8.0%	5.8%	12.2%	5.5%	21.2%
Not Low-Income	7.1%	9.4%	14.4%	3.7%	25.4%
NATIONAL	7.4%	8.0%	13.6%	4.4%	23.8%

Source: 2008 NHIS

Table 4.26. Percent of low-income and non-low-income households with a child who has respiratory problems in PY 2008 (households with children)

Income Group	Percent with Asthma	Percent with Hay Fever	Percent with Allergy	Any Respiratory Problem
Low-Income	13.2%	8.4%	10.1%	23.4%
Not Low-Income	7.7%	10.2%	11.7%	21.3%
NATIONAL	9.6%	9.6%	11.2%	22.0%

Source: 2008 NHIS

Tables 4.27 and 4.28 furnish information on the incidence of circulatory problems in adults and children respectively. In all categories the incidence of circulatory problems among adults is much higher for low-income households than for households that are not low-income. (Table 4.27) For children however, the incidence of circulatory problems is low and there is not much difference between children in low-income households and children in households that are not low-income. For households where one or more individuals have circulatory problems, delivery of weatherization services can improve comfort and health by better maintaining the temperature in the home.

Table 4.27. Percent of low-income and non-low-income households with an adult who has circulatory problems in PY 2008

Income Group	Percent with Diabetes	Percent with Heart Problem	Percent with Problems from Strokes	Percent with Hypertension	Any Circulatory Problem
Low-Income	10.4%	8.7%	3.4%	5.8%	13.8%
Not Low-Income	7.0%	3.4%	1.4%	1.8%	8.7%
NATIONAL	8.3%	5.4%	2.2%	3.3%	10.7%

Source: 2008 NHIS

Table 4.28. Percent of low-income and non-low-income households with a child who has circulatory problems in PY 2008 (households with children)

Income Group	Percent with Diabetes	Percent with Congenital Heart Defect	Percent with Other Heart Disease	Any Circulatory Problem
Low-Income	0.2%	0.1%	1.6%	2.0%
Not Low-Income	0.2%	0.2%	0.8%	1.2%
NATIONAL	0.2%	0.2%	1.1%	1.5%

Source: 2008 NHIS

The NHIS also has information about the rate at which illness caused adults to miss work and children to miss school. The findings from the analysis include:

- Adults that Missed Work – The NHIS shows that 37 percent of adults in low-income households missed work one or more days during the previous 12 months, compared with 49 percent of adults in non-low-income households. However, on average, adults in low-income households missed 12.5 days compared to 8.7 days for adults in households that are not low-income.

- Children that Missed School – The NHIS shows that children in low-income households were more likely to miss school and missed more days than children in households that were not low-income. About 75 percent of low-income children missed one or more days of school, and they missed an average of 5.4 days during the school year. By comparison, 67 percent of children in households that were not low-income missed one or more days of school and missed an average of 4.3 days.

4.6 PROGRAM IMPLICATIONS

This section of the report serves two purposes. First, it helps to document the characteristics of households that are income-eligible for WAP. Second, it documents the incidence of health-related problems for individuals in low-income households that can be potentially addressed in the process of delivering weatherization services.

Some key findings with respect to the demographic characteristics of low-income households include the following:

- Households with Vulnerable Individuals – WAP targets households with elderly individuals, disabled individuals, and children. However, when defined in the most inclusive ways (e.g., elderly individuals over 60, children 18 or younger, and all households with a disabled individual) these households account for 84 percent of all low-income households.

- Household Structure – The analysis shows that low-income households vary considerably – some are made up of elderly individuals, while others are families with children. Some low-income households have just one person, while others have 5 or more.

- Income and Income Sources – The CPS ASEC shows that 86 percent of low-income households had income of $30,000 in 2008, and that for 83 percent of low-income households wages or retirement income (Social Security or pensions) was their primary source of income. Only 13 percent of low-income households received public assistance, and only 6 percent of low-income households had public assistance as their primary source of income.

- Race, Ethnicity, and Language – The population statistics show that the low-income population is diverse, that there are important regional differences in the mix of clients, and that in some regions as many as 20 percent of households are linguistically isolated.

Some key findings with respect to the incidence of health problems include the following:

- Respiratory Problems in Adults – Almost one in four households has an adult with respiratory problems. In general, low-income households experience respiratory problems at the same rate as non-low-income households.

- Respiratory Problems in Children – Over one in five households has a child with respiratory problems. In general, low-income households experience respiratory problems at the same rate as non-low-income households. However, low-income households are almost twice as likely to have a child with asthma as non-low-income households.

- Circulatory Problems – Households with individuals who have circulatory problems can benefit from weatherization services that make home temperatures more uniform. About 14 percent of low-income households have an adult with circulatory problems and about 2 percent of low-income households have a child with these problems.

- Days of Work and School Missed – The NHIS data show that the percent adults in low-income households who miss work due to illness is lower than in non-low-income households, but that the duration is longer. Similarly, the incidence of missing school is only slightly higher for children in low-income households, but the number of days missed is substantially higher.

All of these data are useful in helping to understand the types of households that can be served by WAP and the types of benefits that WAP clients might receive from participation in the program.

5. CHARACTERISTICS OF LOW-INCOME HOUSING UNITS

This section of the report furnishes information on the characteristics of the housing units of households that were low-income in PY 2008. It examines four different dimensions of the population.

- Housing Unit Type and Tenure – The first part of this section presents information on the types of housing units and the household owner/renter status.

- Heating and Cooling – The second part of this section presents information on the type of equipment and fuels used for heating and the type of equipment used for cooling in low-income units.

- Indicators of Energy Efficiency Opportunities - The third part of this section presents information on indicators that can serve as a proxy for energy efficiency opportunities, including both physical factors such as equipment age and behavioral factors such as thermostat settings.

- Housing Quality Indicators – The last part of this section presents information about the incidence of housing quality issues for housing units occupied by low-income households, including: problems with the foundation, walls, windows or roof; problems with rodents; water leaks; and, problems with the primary heating equipment.

The tables in this section of the report show that housing unit types, fuels, energy efficiency opportunities, and quality vary considerably by Climate Zone and Census Region. Those factors can be expected to result in quite different WAP service delivery needs for different subgroups of households and in different parts of the country.

5.1 DATA SOURCES AND METHODOLOGY

The statistics in this section of the report were developed using microdata (i.e., individual household survey records) from the 2005 Residential Energy Consumption Survey (RECS) and from the 2007 AHS. The 2005 RECS data were used to develop statistics of housing unit characteristics, heating and cooling equipment, and indicators of energy efficiency opportunities. Either the RECS data or the AHS data could have been used to develop many of these same statistics. However, the RECS offered three advantages:

- Eligible Population – The RECS has an explicit variable that identifies the households that are low-income. The AHS does not have that variable. The AHS does have measures of income that can be used to characterize a household in terms of their percent of poverty. However, to assess whether a household was low-income, a state identifier also would be needed. That is not available on the AHS data file.

- Content – The RECS is focused specially on energy-related housing unit characteristics including heating equipment and fuels, cooling equipment, an appliance inventory, and energy payment arrangements.

- Energy Savings Opportunities – The RECS data facilitates the identification of energy-saving opportunities for low-income households.

Some important limitations of the RECS data include:

- LIHEAP Households – The RECS public use data file includes an indicator of whether the reported household income was above or below the PY 2008 LIHEAP threshold (i.e., 60 percent of state

median income). Because the income questions for RECS are limited, households tend to underreport income relative to the CPS ASEC statistics. As a result, RECS estimates that there were 38.6 million low-income households, compared to the 35.0 households estimated by the CPS data. As will be demonstrated in this analysis, since energy consumption and expenditures do not increase substantially as income increases, this difference in the estimated size of low-income population has only as small impact on the statistics presented in this report.

- Climate Zone – For purposes of the evaluation, each state is assigned to a Climate Zone. Since the RECS microdata does not include state as a variable, Climate Zone had to be assigned using the information on long term heating and cooling degree days.

- 2005 Data – The 2005 RECS furnishes information for 2005. While housing unit characteristics change slowly over time, there are expected to be some differences between these 2005 statistics and the housing unit characteristics of the low-income population in PY 2008.

- Confidence Intervals - The RECS furnishes high quality information for this analysis. However, because the sample size is relatively small for a national survey, the variability of survey estimates is higher than for the data in other sections of this report.

As part of the analysis, the RECS data were compared to the AHS data where similar questions were asked. In general, the two surveys furnished consistent statistics. However, the heating equipment tables (Tables 5.18 to 5.22) use the AHS data because they furnish better information on unvented heaters and portable heaters.

Since the AHS focuses on issues of housing unit costs and quality, it was used to develop housing quality statistics for low-income households, as well as to furnish some information on the nonenergy costs that might be affected by the delivery of WAP services.

5.2 HOUSING UNIT TYPE, SIZE, AND OWNER/RENTER STATUS

Housing unit type and owner/renter status are important factors that must be considered in treating eligible housing units. Housing unit type is important because each distinct type of building presents a different set of weatherization requirements; a large multi-family building with a central heating system will receive different treatments than a single-family detached home. The owner/renter status for the client is important because, under Section 440.22 of the Federal WAP Regulations, certain conditions must be met if rental units are weatherized using program funds.

Table 5.1 shows the distribution of housing unit type for low-income households. In 2005 about half of low-income households lived in single family detached housing units. However, almost one fourth of low-income households lived in large multi-family units (i.e., buildings with five or more units). Mobile homes, single family attached units, and small multi-family homes have about 10 percent of the low-income population each. Table 5.2 shows what share of the households in each housing unit type were low-income in 2005. Over half of the households in mobile homes, small multi-family dwellings, and large multi-family dwellings were low-income in 2005. However, only about one fourth of households in single family detached homes were low-income.

Table 5.1. Number and percent of low-income households by housing unit type in 2005

Housing Unit Type	Low-income Households (Millions)	Percent of Low-income Households
Mobile Home	3.9	10%
Single Family Detached	18.5	48%
Single Family Attached	3.1	8%
Small Multi-Family (2-4 Units)	4.2	11%
Large Multi-Family (5+ Units)	8.9	23%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.2. Number and percent of households that are low-income by housing unit type in 2005

Housing Unit Type	Low-income Households (Millions)	All Households (Millions)	Percent Low-income
Mobile Home	3.9	6.9	57%
Single Family Detached	18.5	72.1	26%
Single Family Attached	3.1	7.6	40%
Small Multi-Family (2-4 Units)	4.2	7.8	54%
Large Multi-Family (5+ Units)	8.9	16.7	53%
NATIONAL TOTAL	38.6	111.1	35%

Source: 2005 RECS

Table 5.3 shows how the housing unit type for low-income households varies by Climate Zone. The Hot/Dry Climate Zone has the highest percentage of households in mobile homes (14 percent) and multi-family homes (42 percent). The Very Cold Climate Zone has more than 60 percent of its low-income households in single family detached homes.

Table 5.3. Housing unit type as a percent of the low-income population in 2005 by climate zone

Climate Zone	Mobile Home	Single Family Detached	Single Family Attached	Small Multi-Family	Large Multi-Family	All Housing Unit Types
Very Cold Climate	13%	61%	7%	5%	13%	100%
Cold Climate	6%	50%	8%	12%	24%	100%
Moderate Climate	11%	44%	10%	10%	24%	100%
Hot/Dry Climate	14%	37%	7%	15%	27%	100%
Hot/Humid Climate	12%	52%	4%	10%	21%	100%
NATIONAL	10%	48%	8%	11%	23%	100%

Source: 2005 RECS

Table 5.4 shows how the distribution of housing type by Census Region. The Northeast Census Region has almost one-third of its households in large multi-family units, and about half of its households in either large multi-family units or small multi-family units. In addition, single family attached homes (e.g., row houses and duplexes) are found at twice the rate in the Northeast Census Region as in any other Census Region. The South and West Census Regions have 15 percent and 16 percent, respectively, of their low-income households in mobile homes.

Table 5.4. Housing unit type as a percent of the low-income population in 2005 by census region

Census Region	Mobile Home	Single Family Detached	Single Family Attached	Small Multi-Family	Large Multi-Family	All Housing Unit Types
Northeast	3%	34%	14%	17%	32%	100%
Midwest	4%	61%	6%	9%	20%	100%
South	15%	50%	7%	8%	20%	100%
West	16%	42%	7%	12%	23%	100%
NATIONAL	10%	48%	8%	11%	23%	100%

Source: 2005 RECS

The housing unit type statistics demonstrate that WAP program grantees have a wide range of housing unit types to serve, but that the priorities are likely to differ by Census Region. In the Northeast Census Region, grantees may need to understand how to effectively serve large multi-family buildings and row houses, while that may be less important in some other areas of the country.

The average heated square footage for low-income households was 1,179 square feet, compared to 1,852 square feet for households that were not income-eligible for WAP. Table 5.5 shows that about one-half of low-income households lived in homes with 1,000 or fewer heated square feet. A little over one in ten lived in homes with 2,000 or more heated square feet.

Table 5.5. Number and percent of low-income households by square footage in 2005

Heated Square Footage	Low-income Households (Millions)	Percent of Low-income Households
Less than 500	5.4	14%
500 to less than 1,000	14.4	37%
1,000 to less than 1,500	9.4	24%
1,500 to less than 2,000	4.9	13%
2,000 or more	4.4	12%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.6 shows that, on average, homes in the Very Cold Climate Zone were the largest, while homes in the Hot/Dry Climate Zone were the smallest.

Table 5.6. Mean and median heated square footage for low-income households in 2005 by climate zone

Climate Zone	Mean Heated Square Footage	Median Heated Square Footage
Very Cold Climate	1,564	1,218
Cold Climate	1,325	1,024
Moderate Climate	1,173	1,005
Hot/Dry Climate	772	709
Hot/Humid Climate	1,040	925
NATIONAL	1,179	980

Source: 2005 RECS

Table 5.7 shows that, on average, low-income homes in the Midwest Census Region were the largest, while homes in the West Census Region were the smallest.

Table 5.7. Mean and median heated square footage for low-income households in 2005 by census region

Census Region	Mean Heated Square Footage	Median Heated Square Footage
Northeast	1,243	949
Midwest	1,415	1,134
South	1,100	990
West	953	848
NATIONAL	1,179	980

Source: 2005 RECS

Table 5.8 shows how heated square footage varies by housing unit type. About one-half of low-income households live in a single family detached home (Table 5.1); those homes average over 1,500 square feet of heated space. At the other end of the spectrum, about 20 percent of low-income households live in apartments in large multi-family buildings; these units, on average, are less than half of the size of low-income single family detached housing units.

Table 5.8. Mean and median heated square footage for low-income households in 2005 by housing unit type

Housing Unit Type	Mean Heated Square Footage	Median Heated Square Footage
Mobile Home	795	770
Single Family Detached Home	1,545	1,368
Single Family Attached Home	1,183	1,020
Small Multi-Family Home	839	771
Large Multi-Family Home	747	693
NATIONAL	1,179	980

Source: 2005 RECS

Table 5.9 shows that about one half of the income-eligible households own their homes and the other half either rent or occupy without payment of rent. Since half of the income-eligible households are renters, it is important for grantees to develop procedures for working with the property owners for units occupied by low-income renters.

Table 5.9. Number and percent of low-income households by tenure (own/rent) in 2005

Tenure Status	Low-income Households (Millions)	Percent of Low-income Households
Own	20.2	52%
Rent	17.7	46%
Occupy without Rent	0.7	2%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.10 shows that about one in four owners were low-income in 2005, while more than half of renters were low-income.

Table 5.10. Number and percent of households that are low-income by tenure in 2005

Tenure Status	Low-income Households (Millions)	All Households (Millions)	Percent of Households Low-income
Own	20.2	78.1	26%
Rent	17.7	31.8	56%
Occupy without Rent	0.7	1.2	58%
NATIONAL TOTAL	38.6	111.1	35%

Source: 2005 RECS

Table 5.11 shows that homeownership rates for low-income households are highest in the Very Cold Climate Zone (60 percent), and lowest in the Hot/Dry Climate Zone (41 percent). Table 5.12 shows that the Midwest Census Region has the highest percentage of low-income households that own their homes.

Table 5.11. Tenure as a percent of the low-income population in 2005 by climate zone

Climate Zone	Percent Own	Percent Rent	Percent Occupy Without Rent	Total
Very Cold Climate	60%	39%	1%	100%
Cold Climate	56%	43%	1%	100%
Moderate Climate	49%	48%	2%	100%
Hot/Dry Climate	41%	58%	1%	100%
Hot/Humid Climate	56%	42%	2%	100%
NATIONAL	52%	46%	2%	100%

Source: 2005 RECS

Table 5.12. Tenure as a percent of the low-income population in 2005 by census region

Census Region	Percent Own	Percent Rent	Percent Occupy Without Rent	Total
Northeast	45%	54%	1%	100%
Midwest	58%	41%	1%	100%
South	55%	42%	3%	100%
West	47%	52%	1%	100%
NATIONAL	52%	46%	2%	100%

Source: 2005 RECS

Table 5.13 shows how homeownership rates vary by housing unit type. About 80 percent of single family homes and mobile homes are owned by the low-income households who occupy them. In contrast, over 80 percent of low-income households living in small multi-family units and over 90 percent of low-income households living in large multi-family units are renters. Since intake for renters is more complex than intake for owners, and multi-family dwellings are more complex to weatherize than single family units, there are likely to be important policy questions regarding the rate at which these households and housing units are served.

Table 5.13. Tenure as a percent of low-income households in 2005 by housing unit type

Housing Unit Type	Percent Own	Percent Rent	Percent Occupy Without Rent	All Low-income Households
Mobile Home	80%	16%	5%	100%
Single Family Detached	79%	19%	2%	100%
Single Family Attached	36%	63%	1%	100%
Small Multi-Family (2-4 units)	17%	81%	2%	100%
Large Multi-Family Units (5+ units)	7%	92%	<1%	100%
NATIONAL TOTAL	52%	46%	2%	100%

Source: 2005 RECS

5.3 SPACE CONDITIONING EQUIPMENT AND FUELS

The space conditioning (heating and cooling) equipment and fuels are important factors that must be considered in treating eligible housing units. One important goal of WAP is to minimize the energy needed to allow a household to maintain a safe and healthy indoor environment in their home. This is accomplished by ensuring that the heating and cooling equipment is operating as efficiently as possible, by ensuring that all parts of the housing units are effectively heated or cooled, and by eliminating the potential for combustion by-products from contaminating the indoor environment. The procedures for accomplishing these complementary goals are quite different for housing units with different types of heating and cooling systems. Examples include:

- Hydronic Heating System - In a housing unit with a hydronic heating system with a fuel oil boiler, the weatherization procedures must address boiler efficiency and safety issues, as well as ensuring that the system is properly distributing heat to all parts of the home.

- Heat Pump Systems - In a housing unit with a heat pump, the weatherization procedures must ensure that the heat pump unit is properly maintained and that the ducts are sealed and insulated to minimize heat loss and maximize the distribution of heating and cooling to all parts of the home. And, in colder climates, the technician must make sure any back-up system is configured so that it is only used when needed.

- Individual Heating and Cooling Units - In a home with baseboard electric heating units and window air conditioners, the weatherization procedures must ensure that each unit is operating properly and that the window air conditioners are sealed against heat loss in the winter and cooling loss in the summer.

The statistics in this section of the report show that the dominant types of heating and cooling systems vary considerably across the country. However, they also demonstrate that a weatherization sub-grantee is likely to find many different types of systems in its service territory, and it will need to be prepared to address this diversity in the course of normal operations.

Table 5.14 shows that about half of low-income households use natural gas as their main heating fuel, and that about one-third use electricity. However, fuel oil, Liquefied Petroleum Gas (LPG), and wood are also important sources of heat in this population.

Table 5.14. Number and percent of low-income households (LIHEAP criteria) by main heating fuel in 2005

Main Heating Fuel	Low-income Households (Millions)	Percent of Households Low-income
Natural Gas	18.5	48%
Electricity	12.3	32%
Fuel Oil	3.6	9%
LPG	2.0	5%
Wood	1.2	3%
Other	1.0	2%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.15 shows that in most Climate Zones natural gas is the most common main heating fuel. In the Hot/Humid Climate Zone, almost two-thirds of households use electricity as their main heating fuel. Very few households in the Hot/Dry or Hot/Humid Climate Zones use fuel oil as their main source of heat.

Table 5.15. Main heating fuel as a percent of the low-income population in 2005 by climate zone

Climate Zone	Natural Gas	Electricity	Fuel Oil	LPG	Wood	All Main Heating Fuels
Very Cold Climate	59%	10%	18%	5%	6%	100%
Cold Climate	63%	15%	14%	4%	3%	100%
Moderate Climate	45%	32%	11%	7%	4%	100%
Hot/Dry Climate	52%	34%	0%	6%	1%	100%
Hot/Humid Climate	25%	65%	1%	3%	2%	100%
NATIONAL	48%	32%	9%	5%	3%	100%

Source: 2005 RECS

Table 5.16 shows that main heating fuel has a very significant geographic pattern. In the Northeast Census Region, about one-half of households use natural gas and one-third use fuel oil as their main source of heat. In the Midwest Census Region, almost three-fourths of low-income households use natural gas, and most of the rest of the households use electricity. Only one in ten households uses some other main heating fuel. In the South Census Region, more than half of the households use electricity and one-fourth use natural gas. The South Census Region has the highest incidence of LPG main heat of any region (8 percent). In the West Census Region, about one-half of households use natural gas and one-third use electricity.

Table 5.16. Main heating fuel as a percent of the low-income population in 2005 by census region

Census Region	Natural Gas	Electricity	Fuel Oil	LPG	Wood	All Main Heating Fuels
Northeast	52%	9%	33%	1%	3%	100%
Midwest	72%	16%	4%	4%	2%	100%
South	28%	55%	3%	8%	4%	100%
West	50%	34%	1%	5%	3%	100%
NATIONAL	48%	32%	9%	5%	3%	100%

Source: 2005 RECS

Table 5.17 shows that main heating fuels also vary considerably by housing unit type. The most common heating fuel for low-income mobile homes is electricity, in part because electricity is a common heating fuel in the South Census Region and mobile homes are most common in the South Census Region. Natural gas is the most common heating fuel for single family attached homes, in part because this housing unit type is more common where population density is greater, and natural gas is also more common in places where population density is greater.

Table 5.17. Main heating fuel as a percent of the low-income population in 2005 by housing unit type

Housing Unit Type	Natural Gas	Electricity	Fuel Oil	LPG	Wood	All Main Heating Fuels
Mobile Home	27%	42%	9%	12%	5%	100%
Single Family Detached	50%	25%	11%	8%	5%	100%
Single Family Attached	67%	25%	6%	1%	0%	100%
Small Multi-Family (2-4 units)	52%	32%	12%	<1%	2%	100%
Large Multi-Family (5+ units)	44%	45%	6%	1%	<1%	100%
NATIONAL	48%	32%	9%	5%	3%	100%

Source: 2005 RECS

Table 5.18 shows the distribution of main heating equipment for low-income households. The incidence of these systems and the implications for weatherization include the following:

- Ducted Systems – Ducted heating systems are the most common for low-income homes; about 68 percent of homes have these systems. Ducted systems have a central heating unit with ducts to distribute the warm air throughout the home. In such homes, the weatherization team needs to assess the combustion safety and efficiency of the system, make sure that the ducts are distributing the heat to all parts of the home, and try to minimize heat losses of the duct system by sealing and/or insulating the ducts, particularly when they pass through unconditioned space.

- Central Warm Air – Most of the ducted heating systems are central warm air furnaces; they represent about 85 percent of ducted systems and 58 percent of all systems in low-income housing units.
- Heat Pumps – Some of the ducted heating systems are heat pumps. Heat pumps are designed to be higher efficiency than traditional central warm air furnaces. However, the efficiency of the system can be degraded by improperly set back-up systems and if they are not properly maintained.

- Hydronic Systems – About 11 percent of households have hydronic systems. This system is similar to a ducted system, but instead of heating air to be distributed, a boiler heats water or steam that is distributed through pipes. In such homes, the focus is on balancing the system so that heat is distributed throughout the home evenly, and on insulating the pipes that carry the heat.
- Vented Room Heaters / Electric Baseboard Heat – About 9 percent of housing units have vented room heaters and 6 percent have electric baseboard heaters. The weatherization team needs to ensure that such systems are operating safely and efficiently.
- Unvented Room Heaters / Portable Electric Heaters – Unvented room heaters are found in 2 percent of homes, and portable electric heaters are the main heat source in 2 percent of homes. Both of these systems are safety hazards that the weatherization teams attempt to remediate. Since unvented room heaters emit combustion gases directly into the living space, WAP pays for replacement of these units with vented systems. Households most often use portable electric heaters when their other heating system is broken. Since portable heaters represent fire hazards, WAP remediates this problem by paying for repair or replacement of the main heating system.

The variability in heating systems presents important challenges for.

Table 5.18. Number and percent of low-income households by main heating equipment type in 2007

Main Heating Equipment Type	Low-Income Households (Millions)	Percent of Households Low-Income
Ducted	24.2	68%
Central Warm Air	20.6	58%
Heat Pump	3.5	10%
Steam or Hot Water	4.0	11%
Vented Room Heaters	3.3	9%
Electric Baseboard Heaters	2.0	6%
Unvented Room Heaters	0.8	2%
Portable Electric Heaters	0.6	2%
Other	0.4	1%
NATIONAL TOTAL	35.4	100%

Source: 2007 AHS

Table 5.19 shows what share of households using each heating system type are low-income. This table shows that over 60 percent of households using unvented room heaters or portable electric heaters are low-income; these are sub-standard systems that are commonly found when households cannot afford to upgrade to a safer and more effective system.

Table 5.19. Number and percent of households low-income by main heating equipment type in 2007

Main Heating Equipment Type	Low-Income Households (Millions)	All Households (Millions)	Percent Low-Income
Ducted	24.2	82.5	29%
Central Warm Air	20.6	69.5	30%
Heat Pump	3.5	13.0	27%
Hydronic	4.0	12.8	31%
Vented Room Heaters	3.3	7.3	45%
Electric Baseboard Heaters	2.0	4.8	42%
Unvented Room Heaters	0.8	1.3	64%
Portable Electric Heaters	0.6	1.0	61%
Other	0.4	0.9	45%
NATIONAL TOTAL	35.4	110.6	32%

Source: 2007 AHS

Tables 5.20 and 5.21 show the distribution of equipment type by Climate Zone and Census Region. One important finding is that all of the different system types are found in every part of the country. Hydronic systems are found mainly in the Northeast Census Region, and are much less common in other parts of the country. The use of unvented room heaters and portable electric heaters is most common is the Hot/Humid Climate Zone and in the South Census Region.

Table 5.20. Main heating equipment type as a percent of the low-income population in 2007 by climate zone

Climate Zone	Ducted	Hydronic	Vented or Electric Room Heater	Unvented or Portable Electric Room Heater	Other	All Main Heat Equipment Types
Very Cold Climate	66%	21%	13%	<1%	<1%	100%
Cold Climate	64%	21%	13%	1%	1%	100%
Moderate Climate	66%	9%	20%	4%	1%	100%
Hot/Dry Climate	79%	0%	13%	2%	6%	100%
Hot/Humid Climate	79%	<1%	7%	12%	2%	100%
NATIONAL	68%	11%	15%	4%	1%	100%

Source: 2007 AHS

Table 5.21. Main heating equipment type as a percent of the low-income population in 2007 by census region

Census Region	Ducted	Hydronic	Vented Room Heater / Electric Baseboard	Unvented Room Heater / Portable Electric	Other	All Main Heat Equipment Types
Northeast	41%	46%	11%	1%	1%	100%
Midwest	78%	10%	11%	1%	1%	100%
South	78%	1%	11%	9%	1%	100%
West	62%	3%	31%	2%	2%	100%
NATIONAL	68%	11%	15%	4%	1%	100%

Source: 2007 AHS

Table 5.22 shows that main heating equipment types vary considerably by housing unit type. For example, hydronic systems are not found in mobile homes, and unvented room heaters or portable heaters are rarely found in large multi-family buildings. But, again, in most housing unit types all of the different heating equipment types can be found.

Table 5.22. Main heating equipment type as a percent of the low-income population in 2007 by housing unit type

Housing Unit Type	Ducted	Hydronic	Vented Room Heater / Electric Baseboard	Unvented Room Heater / Portable Electric	Other	All Main Heat Equipment Types
Mobile Home	86%	<1%	7%	6%	<1%	100%
Single Family Detached	72%	7%	14%	6%	1%	100%
Single Family Attached	69%	17%	11%	2%	1%	100%
Small Multi-Family (2-4 units)	58%	18%	20%	3%	1%	100%
Large Multi-Family (5+ units)	57%	22%	19%	1%	1%	100%
NATIONAL	68%	11%	15%	4%	1%	100%

Source: 2007 AHS

Another important factor in delivering weatherization services is whether the heating system is located within the targeted housing unit or in a central location that serves multiple units. Table 23 shows nationally, about 12 percent of low-income households live in housing units where there is a central heating system outside their units; most of those are in large multi-family dwellings (5+ units). For large multi-family dwelling, such systems are most common in the Cold and Moderate Climate Zones, and the Northeast Census Region (Table 5.24). For small multi-family dwellings, almost all of the central systems are found in the Northeast Census Region.

Table 5.23. Location of main heating equipment type as a percent of the low-income population in 2005 by climate zone

Climate Zone	Single Family (Mobile Home, Detached, Attached)	Small Multi-Family / In Unit	Small Multi-Family / Outside Unit	Large Multi-Family / In Unit	Large Multi-Family / Outside Unit	All Units
Very Cold Climate	82%	4%	2%	6%	6%	100%
Cold Climate	64%	8%	4%	12%	11%	100%
Moderate Climate	65%	6%	4%	12%	12%	100%
Hot/Dry Climate	59%	14%	<1%	20%	7%	100%
Hot/Humid Climate	70%	9%	1%	17%	3%	100%
NATIONAL	67%	8%	3%	14%	9%	100%

Source: 2005 RECS

Table 5.24. Location of main heating equipment type as a percent of the low-income population in 2005 by census region

Census Region	Single Family	Small Multi-Family / Unit Level	Small Multi-Family / Building Level	Large Multi-Family / Unit Level	Large Multi-Family / Building Level	All Units
Northeast	51%	8%	9%	10%	22%	100%
Midwest	71%	7%	2%	13%	7%	100%
South	73%	7%	1%	15%	4%	100%
West	66%	11%	1%	16%	6%	100%
NATIONAL	67%	8%	3%	14%	9%	100%

Source: 2005 RECS

Table 5.25 shows that about 43 percent of low-income households have central cooling equipment, 35 percent have window or wall units, and that 19 percent do not have cooling equipment. Table 5.26 shows that low-income represent 51 percent of households with window or wall air conditioning units and 42 percent of households that do not have cooling equipment.

Table 5.25. Number and percent of low-income households by cooling equipment type in 2005

Main Cooling Equipment Type	Low-Income Households (Millions)	Percent of Households Low-Income
Heat Pump Central Air	2.6	7%
Central Air (not heat pump)	14.1	36%
Window or Wall Units	13.6	35%
Have But Do Not Use	0.8	2%
No Cooling Equipment	7.5	19%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.26. Number and percent of households that are low-income by cooling equipment type in 2005

Main Cooling Equipment Type	Low-Income Households (Millions)	All Households (Millions)	Percent Low-Income
Heat Pump Central Air	2.6	12.1	22%
Central Air (not heat pump)	14.1	52.4	27%
Window or Wall Units	13.6	26.9	51%
Have But Do Not Use	0.8	1.8	42%
No Cooling Equipment	7.5	17.8	42%
NATIONAL TOTAL	38.6	111.1	35%

Source: 2005 RECS

In the colder Climate Zones, window or wall units are the most common air conditioning equipment type, while in the Hot/Humid Climate Zone, two-thirds of low-income households have central cooling equipment (Tables 5.27 and 5.28). In the Hot/Dry Climate Zone almost half of the low-income households either do not have air conditioning equipment or report that they do not use their air conditioning equipment.[13]

Table 5.27. Main cooling equipment type as a percent of the low-income population in 2005 by climate zone

Climate Zone	Heat Pump	Central Air Conditioning	Window or Wall Unit	Have / Do Not Use	Do Not have	All Low-income Households
Very Cold Climate	0%	27%	42%	1%	29%	100%
Cold Climate	2%	32%	41%	1%	24%	100%
Moderate Climate	7%	37%	39%	2%	16%	100%
Hot/Dry Climate	4%	33%	16%	7%	41%	100%
Hot/Humid Climate	18%	48%	28%	1%	5%	100%
NATIONAL	7%	36%	35%	2%	19%	100%

Source: 2005 RECS

Table 5.28. Main cooling equipment type as a percent of the low-income population in 2005 by census region

Census Region	Heat Pump	Central Air Conditioning	Window or Wall Unit	Have / Do Not Use	Do Not have	All Low-income Households
Northeast	1%	16%	56%	2%	26%	100%
Midwest	3%	49%	38%	0%	10%	100%
South	15%	47%	30%	2%	6%	100%
West	3%	24%	19%	6%	48%	100%
NATIONAL	7%	36%	35%	2%	19%	100%

Source: 2005 RECS

[13]Because the Climate Zones were defined at the state level, the Hot/Dry Climate Zone includes households that have fewer than 2,000 cooling degree days. That accounts for the large number of households with no air conditioning.

Table 5.29 shows how the air conditioning equipment types are distributed by housing unit type. It shows that there are no significant differences in the different housing unit types.

Table 5.29. Main cooling equipment type as a percent of the low-income population in 2005 by housing unit type

Housing Unit Type	Heat Pump	Central Air Conditioning	Window or Wall Unit	Have / Do Not Use	Do Not have	All Low-Income Households
Mobile Home	6%	34%	36%	5%	19%	100%
Single Family Detached	9%	41%	31%	1%	19%	100%
Single Family Attached	2%	38%	38%	0%	23%	100%
Small Multi-Family (2-4 units)	8%	26%	44%	3%	19%	100%
Large Multi-Family (5+ units)	4%	33%	40%	2%	20%	100%
NATIONAL	7%	36%	35%	2%	19%	100%

Source: 2005 RECS

Table 5.30 shows that very few housing units (2%) have a central cooling system located outside the unit.

Table 5.30. Location of main cooling equipment type as a percent of the low-income population in 2005

Housing Unit Type	In Unit	Outside Unit	All Low-Income Households with Air Conditioning
Single Family or Mobile Home	100%	0%	100%
Small Multi-Family	96%	4%	100%
Large Multi-Family	91%	9%	100%
NATIONAL	98%	2%	100%

Source: 2005 RECS

5.4 ENERGY EFFICIENCY OPPORTUNITIES

The RECS contains a number of survey questions that can serve as potential indicators of the energy efficiency opportunities for low-income households, including equipment age, respondent perceptions of heating and cooling adequacy, and information on appliance usage. Equipment and appliance age is particularly relevant to energy savings opportunities, since equipment and appliance efficiency standards have improved the efficiency of newer systems.

For most appliances and equipment, the first national energy efficiency standards were implemented in the early 1990s. For example, boiler and furnace standards were implemented in 1992, central air conditioner standards were implemented in 1992, and water heater standards were implemented in 1990. The 2005 RECS survey questions ask respondents to report on equipment age in categories that include 10 to 19 years, and 20 years or more. In 2005, heating and cooling equipment that was 13 years old would

have been installed prior to efficiency standards and water heating equipment that was 15 years old would have been installed prior to efficiency standards.

Table 5.31 shows that 19 percent of low-income housing units had main heating equipment in 2005 that was 10-19 years old, and 26 percent had equipment that was 20 years old or older. Many of the 10-19 year old units (19 percent) and almost all of the 20 year old units (26 percent) can be expected to be lower efficiency units.

Table 5.31. Number and percent of low-income households by age of heating equipment in 2005

Heating Equipment Age	Low-Income Households (Millions)	Percent of Households Low-Income
Less than 5 years	7.9	21%
5 to 9 years	5.5	14%
10 to 19 years	7.4	19%
20 years or more	9.9	26%
Don't know	7.2	19%
No heating equipment	0.7	2%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.32 shows that 15 percent of low-income housing units had cooling equipment that was 10-19 years old, and 9 percent had equipment that was 20 years old or older. Many of the 10-19 year old units (15 percent) and almost all of the 20 year old units (9 percent) can be expected to have lower efficiency.

Table 5.32. Number and percent of low-income households by age of cooling equipment in 2005

Cooling Equipment Age	Low-Income Households (Millions)	Percent of Households Low-Income
Less than 5 years	11.3	29%
5 to 9 years	6.7	17%
10 to 19 years	5.7	15%
20 years or more	3.5	9%
Don't know	3.8	10%
No cooling equipment	7.5	19%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.33 shows that 16 percent of low-income housing units had main water heating equipment that was 10-19 years old, and 11 percent had equipment that was 20 years old or more. As many as half of the 10-19 year old units and almost all of the 20 year old units can be expected to be lower efficiency units.

Table 5.33. Number and percent of low-income households by age of water heating equipment in 2005

Water Heating Equipment Age	Low-Income Households (Millions)	Percent of Households Low-Income
Less than 5 years	10.2	26%
5 to 9 years	7.2	19%
10 to 19 years	6.2	16%
20 years or more	4.1	11%
Don't know	10.2	26%
No water heater	0.7	2%
NATIONAL TOTAL	38.6	100%

Refrigerator standards were established in 1990, and were updated in 1993 and 2001. In the 2005 RECS, almost all of the 20 year old refrigerators might be expected to be inefficient, as would some of the 10-19 year old refrigerators. Table 5.34 shows that only 6 percent of the primary refrigerators in low-income housing units were 20 years old or older. However, the analysis finds that 15% of low-income households had one or more refrigerators that were 20 years old or older and that many of those were secondary refrigerators.

Table 5.34. Number and percent of low-income households by age of primary refrigerator in 2005

Primary Refrigerator Age	Low-Income Households (Millions)	Percent of Households Low-Income
Less than 5 years	13.8	36%
5 to 9 years	9.5	25%
10 to 19 years	8.8	23%
20 years or more	2.3	6%
Don't know	4.0	10%
No refrigerator	0.1	<1%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Since the RECS survey is conducted by interviewers, not auditors, it is difficult to get accurate information about insulation levels in homes. However, respondents generally have a perception of whether their home is adequately insulated and can report about whether their home is drafty. Table 5.35 shows that 25 percent of low-income households reported that their home was poorly insulated or had no insulation. Table 5.36 shows that 44 percent of households reported that their home was drafty at least some of the time.

Table 5.35. Number and percent of low-income households by adequacy of insulation in 2005

Adequacy of Insulation	Low-Income Households (Millions)	Percent of Households Low-Income
Well Insulated	13.1	34%
Adequately Insulated	14.9	39%
Poorly Insulated	8.7	23%
No Insulation	0.9	2%
Don't know	1.0	3%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.36. Number and percent of low-income households by draftiness in winter in 2005

Draftiness in Winter	Low-Income Households (Millions)	Percent of Households Low-Income
All the time	2.8	7%
Most of the time	2.8	7%
Some of the time	11.2	29%
Never	20.1	52%
Don't know	1.7	4%
NATIONAL TOTAL	38.6	100%

Source: 2005 RECS

Table 5.37 shows that only 32 percent of low-income households reported that they had energy-efficient light bulbs in 2005. That demonstrates that there was a lot of potential for electric savings in low-income households at the time of the 2005 RECS survey.

Table 5.37. Number and percent of low-income households by use of energy efficient bulbs in 2005

Use Energy Efficient Bulbs	Low-Income Households (Millions)	Percent of Households Low-Income
Yes	12.2	32%
No	26.4	68%
NATIONAL TOTAL	24.2	100%

Source: 2005 RECS

These statistics demonstrate that energy efficiency for some, but not all low-income households can be directly improved by air sealing and insulation, equipment replacement, and installation of energy efficient light bulbs. However, these statistics also show that, with the exception of light bulbs, less than one-half of the households have a targeted energy efficiency need.

5.5 HOUSING QUALITY INDICATORS

The AHS contains a number of survey questions that show housing quality problems, some of which can be addressed by WAP, and some of which might actually be barriers to delivery of WAP services.

Table 5.38 shows survey responses for a number of items that might be effectively addressed by WAP. Only about 25 percent of low-income households report having a CO detector; WAP routinely installs CO detectors in homes that have combustion appliances. WAP seals up cracks and fixes broken and boarded up windows; these problems are found in a small percentage of low-income homes. Sealing up the housing unit also can reduce the infestation of rodents and insects into the home. In the AHS survey, about 18 percent of low-income households reported seeing evidence of rodents in their home.

Table 5.38. Percent of low-income households reporting housing quality problems in 2007

Housing Quality Problem	Percent of Households Low-Income
No CO Detector	75%
Open Cracks Wider than a Dime	7%
Windows Broken	6%
Windows Boarded Up	2%
Evidence of Rodents	18%

Source: 2007 AHS

Some of the AHS survey questions are potentially indicators of more serious housing problems that might be a barrier to the delivery of WAP services (Table 5.39). About 4 percent of households report a crumbling foundation that might indicate that there are serious structural problems with the house. Some households report holes in the roof, missing shingles, and a sagging roof surface. This affects about one in ten low-income households. And, about one in ten households report that they had an inside leak in the last 12 months. This problem can introduce moisture into the home where it will cause problems and can be damaging to installed measures.

Table 5.39. Percent of low-income households reporting barriers to WAP as a housing quality problem in 2005

Housing Quality Problem	Percent of Households Low-Income
Crumbling Foundation	4%
Roof Has Holes	3%
Roof Missing Shingles	7%
Roof's Surface Sags	4%
Leak Inside Home	9%

Source: 2007 AHS

The AHS data show that the reported housing problems affect relatively few low-income households. However, together these problems are found in at least 15 percent of homes.

5.6 PROGRAM IMPLICATIONS

This section of the report documents the variations in housing units occupied by low-income households. The finding from this research is that weatherization grantees and subgrantees are likely find a diverse array of housing unit types and configurations, heating and cooling equipment types, and weatherization opportunities in their service territories. The program implication is that they either have to be prepared to understand and address the different challenges that each individual housing unit presents, or they need to

develop policies that focus their efforts on those housing units that they are best prepared to serve effectively. Some important challenges faced by grantees and subgrantees include:

- Housing Unit Type – About one half of low-income households live in single family detached homes and one quarter live in large multi-family homes. Attached single family homes, small multi-family homes, and mobile homes each make up about 10 percent of the population of low-income housing units.

- Ownership Status – Half of low-income households are owners and the other half are renters. However, most low-income owners live in detached single family and mobile homes, while most renters occupy attached single family homes and multi-family buildings. An important challenge for the program is that attached single family and multi-family homes are more complex to weatherize and the administrative procedures for rental units are more complex than for owned units.

- Heating and Cooling Fuel and Equipment Types – The diverse array of equipment types makes it challenging for subgrantees to address the needs of some housing units that they will encounter in the field.

- Energy Efficiency Opportunities - Many low-income housing units have energy efficiency opportunities; they have older equipment, they need additional insulation, and their occupants perceive that they are drafty. However, the national data show that these problems do not always occur in the same housing unit, and many low-income housing units do not appear to exhibit these problems at all. The purpose of energy audits is to sort out which housing units have which energy efficiency opportunities.

- Housing Quality Issues – The data furnished by the AHS suggests that most low-income housing units do not have barriers to weatherization; at least 85 percent of low-income housing units are free from the kinds of structural defects that would present barriers (e.g., leaky roofs). However, some low-income households live in housing units that are substandard and/or present barriers to weatherization.

The WAP Program Regulations directly address these issues. For example, DOE has set policies for treatment of homes with unvented space heaters. Many grantees have developed policies related to deferral of homes with structural problems. This analysis just highlights the importance of these policies.

6. ENERGY CONSUMPTION, EXPENDITURES, AND BURDEN

WAP serves two purposes: it makes energy more affordable for low income households and it reduces energy consumption in the residential market sector. This section of the report identifies the targets of opportunity for the program in terms of meeting these goals by documenting energy consumption, expenditures, and burden for low-income households. Specifically, the study looks at low-income energy use in three ways:

1. Energy Expenditures and Burden – It examines statistics on residential energy expenditures and burden, including both average values and distributions.

2. Energy Consumption – It presents data on the consumption of different types of fuels and different end uses, as well as composite indicators of energy use in terms of Btus per square foot per heating degree day.

3. Energy Affordability – It uses RECS data to show the incidence for key indicators of energy affordability.

As documented in Section 3 of the report, the population of low-income households is far larger than the number of households that can be served with current DOE funding for WAP, even with the extensive amount of leveraged funding that is administered through the weatherization network. This section of the report helps to identify ways to target program resources so that they have the maximum impact in terms of energy and affordability impacts.

6.1 DATA SOURCES AND METHODOLOGY

The statistics in this section of the report were developed using microdata (i.e., individual household survey records) from the 2005 RECS. For this report, the 2005 RECS data were updated to PY 2008 using the following procedures:

1. End Use Adjustment – Space heating consumption was adjusted by the ratio of PY 2008 Heating Degree Day (HDD) / 2005 RECS HDD. Air conditioning consumption was adjusted by the ratio of PY 2008 Cooling Degree Day (CDD) / 2005 RECS CDD. No adjustment was made to water heating or appliance consumption.

2. Expenditures Adjustment – For each fuel used by the household, expenditures were adjusted by the ratio of PY 2008 price / Calendar Year (CY) 2005 price.

These procedures make the RECS data more consistent with the actual consumption and expenditures for PY 2008. However, since they do not account for any behavioral changes in the way that energy was used, they are only a proxy for actual PY 2008 consumption and expenditures. Some limitations of the RECS data include:

- End Use Estimates – The RECS public use data includes variables that disaggregate use of each fuel into its component end uses (e.g., it furnishes data on what share of natural gas was used for space heating, water heating, and appliances). However, since these are statistically derived estimates, there are limits to their precision.

- LIHEAP Households – The RECS public use data file includes an indicator of whether the reported household income was above or below the PY 2008 LIHEAP threshold (i.e., 60 percent of state median income). Because the income questions for RECS are limited, households tend to underreport

income relative to the CPS ASEC statistics. As a result, RECS estimates that there were 38.6 million low-income households in CY 2005, compared to the 35.0 households estimated by the CPS data. As will be demonstrated in this analysis, energy consumption and expenditures do not increase substantially as income increases. So, the difference in the size of the low-income population has only a small impact on the statistics presented in this report.

- Large Multi-Family Dwellings – Table 5.20 shows that about 40 percent of low-income households in large multi-family dwellings do not have their own heating and water heating system; it is furnished by a building level central heating system. Since the RECS survey only collects unit level energy consumption and expenditure data, it does not have measured data for heating and water heating consumption in such buildings. Instead, consumption and expenditure values for each housing unit are imputed using information from other housing units. Since central heating systems for large multi-family buildings might use energy quite differently from heating and water heating systems in individual housing units, there is likely to be some imprecision on the statistics presented for these housing units.

- Climate Zone – For purposes of the evaluation, each state is assigned to a Climate Zone. Since the RECS data does not include state as a variable, Climate Zone had to be assigned using the information on long term heating and cooling degree days.

Even with these limitations, the RECS survey furnishes the best available information on how households use energy in their homes.

6.2 RESIDENTIAL ENERGY EXPENDITURES AND BURDEN

Residential energy expenditures (i.e., expenditures for home heating, home cooling, water heating, and lighting and appliances) and residential energy burden (i.e., the share of annual cash income spent on residential energy) are two important indicators of how energy is used in low-income households and how it affects low-income budgets. Low-income households use different kinds of energy and use energy for different purposes. Some homes are all electric, while other use natural gas for heating, water heating, cooking, and even clothes dryers. Some households have to heat for more than half of the year, while for others air conditioning is a major energy use. However, whatever type of energy they use and for whatever purpose, for most low-income households the concern is the amount that they have to pay for residential energy and the share of the household's income that those expenditures represent. For that reason, this section of the report first examines energy expenditure and burden statistics.

Table 6.1 shows that the projected mean residential energy bill for low-income households in CY 2008 was $1,869 and required 14 percent of household income. One-fourth of households spent more than $2,400 per year for energy and had a burden of more than 15 percent. One in ten had energy bills greater than $3,200 and energy burden greater than 25 percent.

By comparison, Table 6.2 shows that the projected mean residential energy bill for households that were not low-income was $2,340 in CY 2008, about 25 percent higher than the amount spent by low-income households. However, the average energy burden these households was about 3.6 percent of income, considerably lower than the burden for low-income households.

Table 6.1. Projected energy expenditures and burden for low-income households in PY 2008

Statistic	Energy Expenditures	Energy Burden
Mean Value	$1,879	13.9%
Median Value	$1,669	9.7%
Top 25%	$2,411	15.3%
Top 10%	$3,238	26.4%

Source: Adjusted 2005 RECS

Table 6.2. Projected energy expenditures and energy burden for ineligible households in PY 2008

Statistic	Energy Expenditures	Energy Burden
Mean Value	$2,340	3.6%
Median Value	$2,135	3.1%
Top 25%	$2,887	4.7%
Top 10%	$3,839	6.5%

Source: Adjusted 2005 RECS

Tables 6.3 and 6.4 show that energy bills and energy burden vary considerably for low-income households. Table 6.3 shows that 14 percent of households spent more than $3,000 each year on energy in 2008, while 19 percent spent less than $1,000. About one in six low-income households spent less than 5 percent of their income on residential energy, while one in four spent 15 percent or more. The WAP program can expect to find quite different energy savings potential and energy affordability impacts within the population of low-income households.

Table 6.3. Distribution of energy expenditures for low-income households in PY 2008

Energy Expenditures	Number of Households (Millions)	Percent of Households
Less than $1,000	7.1	19%
$1,000 to less than $2,000	17.1	44%
$2,000 to less than $3,000	8.9	23%
$3,000 or More	5.4	14%
NATIONAL TOTAL	38.6	100%

Source: Adjusted 2005 RECS

Table 6.4. Distribution of energy burden for low-income households in PY 2008

Percent of Income	Energy Expenditures	Percent of Households
Less than 5%	5.6	15%
5% to less than 10%	14.5	38%
10% to less than 15%	8.6	22%
15% or more	9.8	25%
NATIONAL TOTAL	38.6	100%

Source: Adjusted 2005 RECS

The RECS data file includes statistically derived estimates of the amount of energy spent on each end use. Table 6.5 shows that for low-income households, it was estimated that almost one-third of the energy bill was for space heating, but that a significant share of the bill was for air conditioning, water heating, and refrigeration. In addition, 34 percent of the bill was for other appliances, including lighting. From that perspective, the expansion of WAP services to cover air conditioning, refrigerators, and lighting in many jurisdictions is consistent with maximizing impacts for low-income households.

Table 6.5. Energy expenditure end use shares for low-income households in PY 2008

End Use	Energy Expenditures	Percent of Expenditures
Space Heating	$595	32%
Air Conditioning	$199	11%
Water Heating	$304	16%
Refrigeration	$149	8%
Other Appliances (including lighting)	$631	34%
NATIONAL TOTAL	$1,879	100%

Source: Adjusted 2005 RECS

Table 6.6 shows how average expenditures vary by the main heating fuel. Households that heated with fuel oil had average expenditure of $3,078 per year and those that heated with LPG had average expenditures of $2,704. By comparison, homes heated with natural gas had average expenditures of $1,817. The price per Btu for fuel oil and LPG is higher than the price per Btu for natural gas; households using the same amount of energy pay more for those fuels.

Table 6.6. Energy expenditures for low-income households in PY 2008 by main heating fuel

Main Heating Fuel	Mean Expenditures	Median Expenditures	Top 25%	Top 10%
Natural Gas	$1,817	$1,634	$2,210	$3,053
Electricity	$1,623	$1,425	$2,067	$2,789
Fuel Oil	$3,078	$3,131	$3,745	$4,082
LPG	$2,704	$2,547	$3,250	$3,830
Other	$1,690	$1,576	$2,258	$2,852
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Table 6.7 shows that the high cost of fuel oil and LPG carries over in the energy burden statistics. The average low-income household that used fuel oil as its main heating fuel had an energy burden of 22.6 percent of income and those that used LPG had an energy burden of 18.5 percent of income, compared to an average energy burden of 12.6 percent for households with natural gas main heat and 13.5 percent for households with electric main heat.

Table 6.7. Energy burden for low-income households in PY 2008 by main heating fuel

Main Heating Fuel	Mean Burden	Median Burden	Top 25%	Top 10%
Natural Gas	12.6%	9.1%	13.8%	23.6%
Electricity	13.5%	8.4%	13.6%	26.0%
Fuel Oil	22.6%	16.1%	25.8%	40.7%
LPG	18. 5%	15.2%	22.0%	26.2%
Other	11.5%	9.5%	13.1%	21.2%
NATIONAL TOTAL	13.9%	9.7%	15.3%	26.4%

Source: Adjusted 2005 RECS

Table 6.8 shows that households living in single family detached homes had the highest average expenditures and that households living in large multi-family dwellings had the lowest. However, Table 6.9 shows that average energy burden was highest for households in small multi-family buildings, mobile homes, and single family detached units.

Table 6.8. Energy expenditure statistics for low-income households in PY 2008 by housing unit type

Housing Unit Type	Mean Expenditures	Median Expenditures	Top 25%	Top 10%
Mobile Home	$1,828	$1,694	$2,234	$2,992
Single Family Detached	$2,172	$1,992	$2,723	$3,568
Single Family Attached	$1,840	$1,724	$2,280	$3,105
Small Multi-Family	$1,926	$1,667	$2,685	$3,377
Large Multi-Family	$1,281	$1,102	$1,485	$2,193
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Table 6.9. Energy burden statistics for low-income households in PY 2008 by housing unit type

Housing Unit Type	Mean Burden	Median Burden	Top 25%	Top 10%
Mobile Home	15.0%	10.3%	14.8%	24.2%
Single Family Detached	13.9%	10.3%	16.1%	24.7%
Single Family Attached	14.2%	9.0%	16.0%	29.0%
Small Multi-Family	17.9%	11.2%	20.4%	38.8%
Large Multi-Family	11.6%	7.2%	11.5%	22.0%
NATIONAL TOTAL	13.9%	9.7%	15.3%	26.4%

Source: Adjusted 2005 RECS

Tables 6.10 and 6.11 show energy expenditure and energy burden statistics by the different demographic target groups (excluding disabled households).[14] Mean expenditures are above average for households with children and below average for other households. Elderly households had energy expenditures just

[14]No information on disability was available from the 2005 RECS survey.

slightly below the average for all low-income households. However, while households with children had the highest energy expenditures among the targeted groups, they had the lowest average energy burden.

Table 6.10. Energy expenditure statistics for low-income households in PY 2008 by demographic target group

Demographic Target Group	Mean Expenditures	Median Expenditures	Top 25%	Top 10%
Elderly	$1,806	$1,576	$2,362	$3,286
Children (18 or younger)	$2,135	$1,957	$2,760	$3,523
Other (No elderly or child)	$1,661	$1,512	$2,059	$2,931
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Table 6.11. Energy burden statistics for low-income households in PY 2008 by demographic target group

Demographic Target Group	Mean Burden	Median Burden	Top 25%	Top 10%
Elderly	14.5%	10.6%	17.6%	26.2%
Children(18 or younger)	12.8%	8.3%	13.1%	23.4%
Other (No elderly or child)	15.6%	10.6%	16.2%	29.5%
NATIONAL TOTAL	13.9%	9.7%	15.3%	26.4%

Source: Adjusted 2005 RECS

Tables 6.12 and 6.13 show energy expenditure and energy burden statistics for low-income households by poverty level. Households with income below the poverty line had the lowest mean energy expenditures, but the highest mean energy burden. These households had mean energy bills of $1,792, about 5 percent less than the mean for all low-income households. However, they had mean energy burdens of 21.3 percent, more than twice the energy burden for households in the next poverty group.

Table 6.12. Energy expenditure statistics by poverty level for low-income households in PY 2008

Poverty Level	Mean Expenditures	Median Expenditures	Top 25%	Top 10%
Less than 100%	$1,792	$1,575	$2,260	$3,221
100% to less than 150%	$1,875	$1,668	$2,391	$3,212
150% to less than 200%	$1,997	$1,837	$2,547	$3,238
200% or more	$2,253	$2,116	$3,056	$3,856
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Table 6.13. Energy burden statistics by poverty level for low-income households in PY 2008

Poverty Level	Mean Burden	Median Burden	Top 25%	Top 10%
Less than 100%	21.3%	14.9%	24.4%	39.0%
100% to less than 150%	9.0%	8.0%	11.2%	14.8%
150% to less than 200%	7.5%	6.9%	9.2%	12.6%
200% or more	6.4%	5.7%	8.4%	10.6%
NATIONAL TOTAL	13.9%	9.7%	15.3%	26.4%

Source: Adjusted 2005 RECS

Table 6.14 shows that the average energy bill for low-income owners is about 30 percent higher than the average for low-income renters, and that the average burden for owners is more than 20 percent higher than that of renters (Table 6.15). However, Table 6.16 shows that these differences are somewhat smaller when compared with the same housing unit type. For example, energy expenditures for mobile home owners and renters are about the same, energy expenditures for single family home owners are only 10 percent higher than for renters.

Table 6.14. Energy expenditure statistics by tenure for low-income households in PY 2008

Tenure	Mean Expenditures	Median Expenditures	Top 25%	Top 10%
Owner	$2,112	$1,943	$2,637	$3,472
Renter	$1,622	$1,389	$2,049	$2,990
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Table 6.15. Energy burden statistics by tenure for low-income households in PY 2008

Tenure	Mean Burden	Median Burden	Top 25%	Top 10%
Owner	15.3%	10.6%	16.5^	28.7%
Renter	12.4%	8.5%	13.5%	24.4%
NATIONAL TOTAL	13.9%	9.7%	15.3%	26.4%

Source: 2005 RECS

Table 6.16. Energy expenditure statistics by tenure and housing unit type for low-income households in PY 2008

Tenure / Housing Unit Type	Mean Expenditures	Median Expenditures	Top 25%	Top 10%
Mobile Home Owners	$1,826	$1,694	$2,317	$3,097
Mobile Home Renters	$1,834	$1,901	$2,140	$2,952
Single Family Owners	$2,185	$2,015	$2,730	$3,528
Single Family Renters	$1,965	$1,753	$2,432	$3,154
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Tables 6.17 and 6.18 show energy expenditure and burden statistics by Climate Zone. Households in the Very Cold Climate Zone had the highest average energy expenditures (about 10 percent above the average for all low-income households) and those in the Hot/Dry Climate Zone had the lowest energy expenditures (about 30 percent below average). Households in the Hot/Humid Climate Zone had the highest energy burden, even though their energy expenditures were about average for low-income households.

Table 6.17. Energy expenditure statistics for low-income households in PY 2008 by climate zone

Climate Zone	Mean	Median	Top 25%	Top 10%
Very Cold Climate	$2,135	$1,992	$2,547	$3,744
Cold Climate	$1,970	$1,737	$2,454	$3,485
Moderate Climate	$1,917	$1,691	$2,534	$3,234
Hot/Dry Climate	$1,316	$1,066	$1,590	$2,368
Hot/Humid Climate	$1,879	$1,748	$2,426	$3,016
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Table 6.18. Energy burden statistics for low-income households in PY 2008 by climate zone

Climate Zone	Mean	Median	Top 25%	Top 10%
Very Cold Climate	13.7%	10.4%	14.3%	23.0%
Cold Climate	14.0%	10.0%	16.7%	26.5%
Moderate Climate	13.8%	10.2%	15.3%	26.6%
Hot/Dry Climate	9.4%	5.9%	9.3%	15.6%
Hot/Humid Climate	16.6%	10.0%	16.9%	31.8%
NATIONAL TOTAL	13.9%	9.7%	15.3%	26.4%

Source: Adjusted 2005 RECS

Tables 6.19 and 6.20 show energy expenditure and burden statistics by Census Region. Households in the Northeast Census Region had the highest average energy expenditures (about 25 percent above the average for all low-income households). In part, this is a result of the high incidence in the Northeast of fuel oil, which is more expensive per Btu than other heating fuels. Households in the West Census Region had the lowest average expenditures (about 25 percent below average). Households in the Northeast and the South Census Regions had the highest average energy burdens. In the Northeast Census Region, high average expenditures resulted in a high average energy burden. In the South Census Region, lower average income resulted in a high average energy burden.

Table 6.19. Energy expenditure statistics for low-income households in PY 2008 by census region

Census Region	Mean	Median	Top 25%	Top 10%
Northeast	$2,343	$2,165	$3,148	$3,934
Midwest	$1,891	$1,714	$2,258	$3,052
South	$1,850	$1,694	$2,398	$3,053
West	$1,400	$1,190	$1,724	$2,368
NATIONAL TOTAL	$1,879	$1,669	$2,411	$3,238

Source: Adjusted 2005 RECS

Table 6.20. Energy burden statistics for low-income households in PY 2008 by census region

Census Region	Mean	Median	Top 25%	Top 10%
Northeast	16.1%	11.0%	17.7%	29.5%
Midwest	13.4%	10.2%	15.7%	23.9%
South	15.2%	10.2%	16.3%	28.7%
West	9.8%	6.3%	10.2%	17.1%
NATIONAL TOTAL	13.9%	9.7%	15.3%	26.4%

Source: Adjusted 2005 RECS

As might be expected, the share of energy expenditures used for different end uses varied considerably by Climate Zone. Almost half of energy expenditures in the Very Cold Climate Zone were attributed to space heating. In the Hot/Humid Climate Zone only 11 percent of energy expenditures Climate Zone were attributed to heating, but 28 percent of expenditures were attributed to air conditioning. In the Hot/Dry Climate Zone, over half of the energy expenditures were attributed to appliances (Table 6.21).

Table 6.21. Energy end use shares for low-income households in PY 2008 by climate zone

Climate Zone	Heating Percent	Cooling Percent	Water Heating Percent	Appliance Percent	Total
Very Cold Climate	46%	2%	14%	39%	100%
Cold Climate	43%	4%	14%	40%	100%
Moderate Climate	35%	8%	16%	41%	100%
Hot/Dry Climate	10%	15%	23%	51%	100%
Hot/Humid Climate	11%	28%	17%	44%	100%
NATIONAL TOTAL	32%	11%	16%	42%	100%

Source: Adjusted 2005 RECS

Table 6.22 shows the attribution of expenditure end use shares by Census Region. In the Northeast Census Region, 45 percent of expenditures are attributed to space heating, while in the South Census Region space heating and air conditioning each account for about 20 percent of residential energy expenditures.

Table 6.22. Energy end use shares for low-income households in PY 2008 by census region

Census Region	Heating Percent	Cooling Percent	Water Heating Percent	Appliance Percent	Total
Northeast	45%	3%	14%	38%	100%
Midwest	41%	5%	15%	39%	100%
South	20%	20%	17%	43%	100%
West	20%	10%	22%	49%	100%
NATIONAL TOTAL	32%	11%	16%	42%	100%

Source: Adjusted 2005 RECS

The opportunities for saving energy in the homes of low-income households are different in the different Climate Zones and Census Regions. In the Northeast Census Region, the focus is much more on space heating, while in the Hot/Humid Climate Zone, air conditioning accounts for almost three times as much of energy expenditures as space heating.

6.3 RESIDENTIAL ENERGY CONSUMPTION

This section of the report presents statistics for energy consumption. The analysis includes information on consumption in physical units by fuel type (e.g., 100 cubic feet (CCF) of natural gas), as well as combined data for all fuel types in energy units (i.e., Btus). This section also includes indicators of energy intensity (e.g., Btu per square foot per heating degree day).

Table 5.10 showed that almost half of low-income households had natural gas main heating fuel in PY 2008. On average, low-income households used 768 CCF of natural gas and 7,283 kWh of electricity (Table 6.23). Households that were not low-income used only about 4 percent more natural gas, but over 40 percent more electricity (Table 6.24). About one-third of low-income households used less than 500 CCF of gas, and about one-fourth used more than 1,000 CCF (Table 6.25).

Table 6.23. Natural gas and electric energy usage for low-income households with natural gas main heat in PY 2008

Statistic	Natural Gas Usage (CCFs)	Electric Usage (kWh)
Mean Value	768	7,283
Median Value	682	6,131
Top 25%	972	9,525
Top 10%	1,308	13,369

Source: Adjusted 2005 RECS

Table 6.24. Natural gas and electric energy usage for ineligible households with natural gas main heat in PY 2008

Statistic	Natural Gas Usage (CCFs)	Electric Usage (kWh)
Mean Value	799	10,326
Median Value	698	8,875
Top 25%	1,025	13,375
Top 10%	1,389	18,841

Source: Adjusted 2005 RECS

Table 6.25. Distribution of natural gas usage for low-income households with natural gas main heat in PY 2008

Energy Usage	Number of Households (Millions)	Percent of Households
Less than 500 ccf	5.7	31%
500 CCF to less than 1000 CCF	8.4	45%
1,000 CCF to less than 1,500 CCF	3.1	17%
1,500 CCF or more	1.3	7%
NATIONAL TOTAL	18.5	100%

Source: Adjusted 2005 RECS

Table 6.26 shows that natural gas and electricity consumption patterns vary significantly by Climate Zone. As might be expected, the Very Cold Climate Zone has the highest average gas usage and moderate electric usage. In the Hot/Humid Climate Zone, usage of natural gas is less than half that in the colder Climate Zones, but electricity usage is more than 50 percent higher. The Hot/Dry Climate Zone has the lowest average use of both natural gas and electricity.

Table 6.26. Natural gas and electricity usage for low-income households with natural gas main heat in PY 2008 by climate zone

Climate Zone	Mean Natural Gas Usage	Mean Electricity Usage
Very Cold Climate	968	7,066
Cold Climate	923	6,773
Moderate Climate	768	7,533
Hot/Dry Climate	388	5,147
Hot/Humid Climate	445	11,054
NATIONAL TOTAL	768	7,283

Source: Adjusted 2005 RECS

Table 6.27 shows that natural gas and electricity consumption patterns also vary significantly by Census Region. The Midwest Census Region has the highest average usage of gas, about 23 percent higher than the average. The South Census Region has the highest average use of electricity for natural gas main heat households, about 35 percent higher than the average.

Table 6.27. Natural gas and electricity usage for low-income households with natural gas main heat in PY 2008 by census region

Census Region	Mean Natural Gas Usage	Mean Electricity Usage
Northeast	880	5,791
Midwest	946	7,502
South	580	9,839
West	508	5,881
NATIONAL TOTAL	768	7,283

Source: Adjusted 2005 RECS

One-third of low-income households had electricity as their main heating fuel in PY 2008 (Table 5.10); mean electric use was 13,345 kWh (Table 6.28). Households that were not low-income used about 25 percent more than low-income households (Table 6.29). About 40 percent used less than 10,000 kWh of electricity and about 18 percent used 20,000 kWh or more (Table 6.30).

Table 6.28. Electricity usage for low-income households with electric main heat in PY 2008

Statistic	Electric Usage (kWh)
Mean Value	13,345
Median Value	12,172
Top 25%	17,643
Top 10%	22,562

Source: Adjusted 2005 RECS

Table 6.29. Electricity usage for ineligible households with electric main heat in PY 2008

Statistic	Electric Usage (kWh)
Mean Value	16,774
Median Value	16,450
Top 25%	21,822
Top 10%	26,665

Source: Adjusted 2005 RECS

Table 6.30. Distribution of electricity usage for low-income households with electric main heat in PY 2008

Energy Usage	Number of Households (Millions)	Percent of Households
Less than 5000 kWh	1.4	12%
5,000 kWh to less than 10,000 kWh	3.4	28%
10,000 kWh to less than 15,000 kWh	3.0	24%
15,000 kWh to less than 20,000 kWh	2.3	18%
20,000 kWh to less than 25,000 kWh	1.4	12%
25,000 kWh or more	0.8	6%
NATIONAL TOTAL	12.3	100%

Source: Adjusted 2005 RECS

Low-Income households with electric main heat in the Very Cold Climate Zone consume about 10 percent less electricity than the average for all low-income households, and households in the Hot/Humid Climate Zone consume about 10 percent more than the average (Table 6.31). In the Hot/Dry Climate Zone, low-income households with electric heat use about 40 percent less than the national average.

Table 6.31. Electricity usage for low-income households with electric main heat in PY 2008 by climate zone

Climate Zone	Mean Electricity Usage
Very Cold Climate	11,816
Cold Climate	13,330
Moderate Climate	13,688
Hot/Dry Climate	8,408
Hot/Humid Climate	14,623
NATIONAL TOTAL	13,345

Source: Adjusted 2005 RECS

Households with electric main heat in the South Census Region consume about 10 percent more electricity than the average for all low-income households, and households in the Northeast and West Census Regions consume almost 20 percent less than the average (Table 6.32).

Table 6.32. Electricity usage for low-income households with electric main heat in PY 2008 by census region

Census Region	Mean Electricity Usage
Northeast	11,018
Midwest	13,181
South	14,551
West	10,463
NATIONAL TOTAL	13,345

Source: Adjusted 2005 RECS

About 9 percent of low-income households had fuel oil as their main heating fuel in PY 2008 (Table 5.10). On average these households used 790 gallons of fuel oil and 6,571 kWh of electricity (Table 6.33). Households that were not low-income used about 11 percent more fuel oil and about 50 percent more electricity than low-income households (Table 6.34). Almost two-thirds of low-income households used 500 to 1,000 gallons of fuel oil in a year (Table 6.35).

Table 6.33. Fuel oil and electric energy usage for low-income households with fuel oil main heat in PY 2008

Statistic	Fuel Oil Usage (gallons)	Electric Usage (kWh)
Mean Value	790	6,571
Median Value	769	5,305
Top 25%	960	8,574
Top 10%	1,143	11,557

Source: Adjusted 2005 RECS

Table 6.34. Fuel oil and electric energy usage for ineligible households with fuel oil main heat in PY 2008

Statistic	Fuel Oil Usage (gallons)	Electric Usage (kWh)
Mean Value	878	10,055
Median Value	793	8,895
Top 25%	1,061	12,109
Top 10%	1,295	17,315

Source: Adjusted 2005 RECS

Table 6.35. Distribution of fuel oil usage for low-income households with fuel oil main heat in PY 2008

Energy Usage	Number of Households	Percent of Households
Less than 500 gallons	0.4	13%
500 gallons to less than 1,000 gallons	1.9	64%
1,000 gallons to less than 1,500 gallons	0.7	22%
1,500 gallons or more	<0.1	<1%
NATIONAL TOTAL	3.0	100%

Source: Adjusted 2005 RECS

Tables 6.36 and 6.37 show that there is very little difference in average fuel oil consumption either by Climate Zone or by Census Region. (Note: Since very little fuel oil is used in certain Climate Zones and Census Regions, statistics are not shown for those geographies.)

Table 6.36. Fuel oil and electricity usage for low-income households with fuel oil main heat in PY 2008 by climate zone

Climate Zone	Mean Fuel Oil Usage	Mean Electricity Usage
Very Cold Climate	812	6,166
Cold Climate	790	6,850
Moderate Climate	780	6,489
Hot/Dry Climate	N/A	N/A
Hot/Humid Climate	N/A	N/A
NATIONAL TOTAL	878	10,055

Source: Adjusted 2005 RECS

Table 6.37. Fuel oil and electricity usage for low-income households with fuel oil main heat in PY 2008 by census region

Census Region	Mean Fuel Oil Usage	Mean Electricity Usage
Northeast	811	6,063
Midwest	708	6,287
South	N/A	N/A
West	N/A	N/A
NATIONAL TOTAL	878	10,055

Source: Adjusted 2005 RECS

About 5 percent of low-income households had LPG as their main heating fuel in PY 2008 (Table 5.10). On average these households used 598 gallons of LPG and 12,078 kWh of electricity (Table 6.38). LPG main heaters use less LPG and more electricity than fuel oil main heaters, in part because more LPG households were in the Hot and Moderate Climate Zones, while most Fuel Oil households were in the Very Cold and Cold Climate Zones. Households that were not low-income used about 35 percent more LPG, but only 4 percent more electricity (Table 6.39). Most LPG main heaters use less than 1,000 gallons per year (Table 6.40).

Table 6.38. LPG and electric energy usage for low-income households with LPG main heat in PY 2008

Statistic	LPG Usage (gallons)	Electric Usage (kWh)
Mean Value	598	12,078
Median Value	541	10,489
Top 25%	791	15,258
Top 10%	1,000	21,604

Source: Adjusted 2005 RECS

Table 6.39. LPG and electric energy usage for ineligible households with LPG main heat in PY 2008

Statistic	LPG Usage (gallons)	Electric Usage (kWh)
Mean Value	813	12,519
Median Value	738	11,267
Top 25%	1,057	15,776
Top 10%	1,374	20,931

Source: Adjusted 2005 RECS

Table 6.40. Distribution of LPG usage for low-income households with LPG main heat in PY 2008

Energy Usage	Number of Households	Percent of Households
Less than 500 gallons	0.9	44%
500 gallons to less than 1,000 gallons	0.9	45%
1,000 gallons to less than 1,500 gallons	0.2	9%
1,500 gallons or more	<0.1	2%
NATIONAL TOTAL	2.0	100%

Source: Adjusted 2005 RECS

Tables 6.41 and 6.42 show that LPG and electricity usage varies quite a bit by Climate Zone and Census Region. However, since the sample size of households with LPG main heat is relatively small, a certain amount of the variability may be a result of the small sample.

Table 6.41. LPG and electricity usage for low-income households with LPG main heat in PY 2008 by climate zone

Climate Zone	Mean LPG Usage	Mean Electricity Usage
Very Cold Climate	739	10,264
Cold Climate	698	14,463
Moderate Climate	578	12,280
Hot/Dry Climate	572	7,791
Hot/Humid Climate	434	12,737
NATIONAL TOTAL	598	12,078

Source: Adjusted 2005 RECS

Table 6.42. LPG and electricity usage for low-income households with LPG main heat in PY 2008 by census region

Census Region	Mean LPG Usage	Mean Electricity Usage
Northeast	757	9,747
Midwest	728	16,355
South	548	11,465
West	559	10,197
NATIONAL TOTAL	598	12,078

Source: Adjusted 2005 RECS

It is valuable to look at the energy use of low-income households in physical units, since that will be most meaningful to most program managers. However, since each of the different energy sources has a different energy content, it is important to have a way to compare energy usage, and potential energy savings, across different energy types. One way to do this is to convert each of the physical units of energy (e.g., gallons) to British thermal units (Btus), which is a unit of energy. For example, one kWh is equal to 3,142 Btus. The RECS data includes both physical units for each fuel (e.g., gallons) and energy units (i.e., Btus). Table 6.43 shows that low-income households used 86.1 MMBtu of energy in PY 2008. Households with incomes above the eligibility threshold used 103.9 MMBtu, about 21 percent more than low-income households. That is consistent with the finding from Tables 6.1 and 6.2 that showed that ineligible households had energy bills that were about 25 percent higher than those of low-income households.

Table 6.43 shows Btus in terms of both site and source energy. Site energy is a direct measurement of the energy content of the fuels consumed on site by households. For that analysis, there was a direct conversion from the physical units reported by the energy supplier to the energy units reported in the RECS data file. However, since in most cases fossil fuels were burned to generate electricity, it is important to consider the total amount of energy consumed in the generation of energy. EPA has developed a conversion factor of 3.34 for "source energy." In Table 6.43, the source energy column was developed by multiplying each electricity Btu by 3.34. Table 6.43 shows that low-income households had average consumption of 86.1 site MMBtu in 2008 and 162.3 source MMBtu. Households that were not income-eligible for WAP used about 20 percent more site MMBtu and 25 percent more source MMBtu than low-income households(Table 6.44). Table 6.45 shows the distribution of MMBtu consumed by low-income households.

Table 6.43. Total energy usage for low-income households in PY 2008

Statistic	Usage (site MMBtus)	Usage (source MMBtus)
Mean Value	86.1	162.3
Median Value	76.4	152.4
Top 25%	115.7	210.7
Top 10%	156.0	259.1

Source: Adjusted 2005 RECS

Table 6.44. Total energy usage for ineligible households PY 2008

Statistic	Usage (site MMBtus)	Usage (source MMBtus)
Mean Value	103.9	202.3
Median Value	93.2	191.1
Top 25%	134.3	251.8
Top 10%	176.5	326.6

Source: Adjusted 2005 RECS

Table 6.45. Distribution of total energy usage for low-income households in PY 2008

Energy Usage (Site Btu)	Number of Households (Millions)	Percent of Households
Less than 50 MMBtus	10.7	28%
50 MMBtus to less than 100 MMBtus	15.4	40%
100 MMBtus to less than 150 MMBtus	8.1	21%
150 MMBtus to less than 200 MMBtus	3.3	9%
200 MMBtus or more	1.1	3%
NATIONAL TOTAL	38.6	100%

Source: Adjusted 2005 RECS

Tables 6.46 and 6.47 show that comparisons of average site MMBtu and average source MMBtu by Climate Zone and Census Region yield quite different results. The Very Cold and Cold Climate Zones have substantially higher site MMBtu than the other Climate Zones, but source MMBtu averages are similar across all Climate Zones, with only the Hot/Dry Climate Zone using less source MMBtu than the other zones. Similarly, the average site MMBtu consumption is higher in the Northeast and Midwest Census Regions, but those differences are much smaller when examining source MMBtu statistics. Only the West Census Region has average source consumption that is significantly different from the other Census Regions.

Table 6.46. Total energy usage for low-income households in PY 2008 by climate zone

Climate Zone	Usage (site MMBtus)	Usage (source MMBtus)
Very Cold Climate	111.6	174.7
Cold Climate	105.7	171.3
Moderate Climate	87.1	165.8
Hot/Dry Climate	57.6	109.3
Hot/Humid Climate	61.0	167.4
NATIONAL TOTAL	86.1	162.3

Source: Adjusted 2005 RECS

Table 6.47. Total energy usage for low-income households in PY 2008 by census region

Census Region	Usage (site MMBtus)	Usage (source MMBtus)
Northeast	108.8	160.8
Midwest	109.2	179.7
South	68.3	169.0
West	65.1	128.7
NATIONAL TOTAL	86.1	162.3

Source: Adjusted 2005 RECS

One metric that analysts use for examining energy saving potential across different fuels, climates, and building types is energy usage intensity. For this analysis, energy use intensity is defined as Btu per square foot, heating energy use intensity is defined as heating Btu per square foot per HDD (base 65 degrees), and cooling energy use intensity is defined as cooling Btu per square foot per CDD (base 65 degrees). Table 6.48 shows the energy use intensity for low-income households compared to households that are not low-income. Energy use intensity for low-income households is higher than for non-low-income households; 26 percent higher for overall energy use, 39 percent higher for space heating, and 8 percent higher for cooling.

Table 6.48. Energy use intensity for low-income households in PY 2008 by WAP eligibility

Eligibility Group	Overall Energy Use Intensity (Source Btu per square foot)	Heating Energy Use Intensity (Source Btu per square foot per HDD 65)	Cooling Energy Use Intensity (Source Btu per square foot per CDD 65)
Low-income	172,963	12.5	13.5
Not Low-income	137,429	9.0	12.5
NATIONAL TOTAL	149,549	10.2	12.8

Source: Adjusted 2005 RECS

One reason for the higher level of energy intensity for low-income households is because the average home size is much smaller for low-income households than other households, but the average number of people per home is about the same. For example, the primary determinant of the amount of energy used for water heating is the number of people in the home. If a two-person low-income household uses 24 MMBtu for water heating in a 1,000 square foot home, the energy intensity is 24,000 Btu per square

foot. But, if a two-person non low-income household uses 24 MMBtu for water heating in a 2,000 square foot home, the energy intensity is only 12,000 Btu per square foot.

With respect to heating energy use per square foot per HDD, the higher energy intensity is a result of two factors. First, since low-income housing units are smaller, there is more surface area per square foot than in a larger home. So, there is more opportunity for a small home to lose energy through conduction. Second, low-income housing units are more likely to be drafty (i.e., have air leakage) and to be poorly insulated than non-low-income households. So, homes for low-income households are less efficient than for non-low-income households. At the same time, low-income households keep their homes at a lower average temperature than non-low-income households.

6.4 RESIDENTIAL ENERGY AFFORDABILITY INDICATORS

The 2005 RECS Survey included a battery of questions that asked low-income households to report on different dimensions of energy affordability, including difficulty paying energy bills, trade-offs made to pay energy bills, and the loss of energy service due to nonpayment. The tables in this section document the incidence of energy affordability problems for low-income households and report the results of an analysis of the factors associated with energy problems that was conducted for the Federal LIHEAP Program Office.

One problem that some low income households face when they are unable to pay their energy bills is that they go without energy service and are unable to heat their homes with their main heating equipment when heat is needed.[15] Table 6.49 presents data from the 2005 RECS on space heating disruptions for low income households. The table shows the number and percent of low income households that experienced each type of space heating disruption. Table 6.49 shows that almost 1.6 million low income households had a space heating disruption because of the inability to pay for the repair of a broken heating system, and such disruptions affected 4.4 percent of the entire population of low income households.

Table 6.49. Inability to use main source of heat when needed for low-income households in 2005 by reason for disruption

Reason for Space Heating Disruption	Number of Low-Income Households	Percent of Low-Income Households
Inability to pay for the repair of a broken heating system	1,581,233	4.4%
Inability to pay for a bulk fuel delivery	300,284	0.8%
Inability to pay for electric service	1,671,636	4.7%
Inability to pay for gas service	621,956	1.7%
DISRUPTION FOR ANY REASON	3,265,563	9.1%

Source: 2005 RECS

Table 6.50 furnishes data from the series of RECS surveys regarding the number of low income households that have reported bill payment related space heating disruptions over time. These statistics

[15]Note that the data does not provide information on the total number of shutoffs (e.g. spring shutoffs in moratoria States when heat is not needed) for the entire year.

show that during the winter of 2004-2005, bill payment related space heating disruptions were the highest of any year since the question was first asked in the 1984 RECS.[16]

Table 6.50. Inability to use main source of heat because of payment problems for low-income households, selected years

Heating Season	Percent of Low-Income Households with Payment-Related Disruptions
1983-1984	5.1%
1987-1988	2.1%
1990-1991	4.1%
1996-1997	3.6%
2001-2001	2.7%
2004-2005	5.9%

Source: FY 2008 LIHEAP Home Energy Notebook

Another problem that some low income households face when they are unable to pay their energy bills is that they go without energy service and are unable to cool their homes with their air conditioning equipment when cooling is needed.[17] Table 6.51 presents data from the 2005 RECS on air conditioning disruptions for low income households. The table shows the number and percent of low income households that experienced each type of air conditioning disruption. Table 6.51 shows that over 1.2 million low income households had an air conditioning disruption because of the inability to pay for electric service, and such disruptions affected 3.5 percent of the entire population of low income households. Overall, air conditioning disruptions were split evenly between equipment disruptions and electric service disruptions.

Table 6.51. Inability to use air conditioning when needed for low-income households in 2005 by reason for disruption

Reason for Air Conditioning Disruption	Number of Low-Income Households	Percent of Low-Income Households
Inability to pay for the repair of a broken air conditioner	1,427,509	4.0%
Inability to pay for electric service	1,240,278	3.5%
DISRUPTION FOR ANY REASON	2,507,547	7.0%

Source: 2005 RECS

The 2005 RECS also asked low income survey respondents questions related to the financial dimension of energy affordability. Table 6.52 presents data from the 2005 RECS on the financial elements of energy affordability for low income households. For affordability problem, the table shows the percent of low income households that experienced that type of problem. The last row of Table 6.52 shows that 42.2 percent of low income households reported no financial energy affordability problem, while 57.8 percent of low income households had at least one type of financial energy affordability problem during the preceding 12 months. The most common types of financial energy affordability problems were

[16]Some of the previous RECS surveys have also collected information on equipment related interruptions. The historical data on this type of interruption were not readily available for this study.

[17]Note that the data does not provide information on the total number of shutoffs (e.g. autumn shutoffs in moratoria States when cooling is not needed) for the entire year.

"worry about ability to pay" and "reduce spending for basic necessities." Over half of low income households indicated that they experienced one or both of those problems at least once during 2005.

Table 6.52. Financial energy affordability problems in the preceding 12 months for low-income households in 2005

Affordability Problem	Almost Every Month	Some Months	1 or 2 Months	Never
Worry about ability to pay energy bill	14.9%	23.6%	7.4%	54.1%
Reduce spending for basic necessities	17.0%	23.3%	6.7%	53.0%
Borrow to pay bill	3.9%	11.6%	7.2%	77.3%
Skip paying bill	3.9%	13.0%	9.4%	73.7%
Service termination notice	2.7%	8.7%	9.5%	79.2%
ANY PROBLEM	23.6%	25.4%	8.9%	42.2%

Source: 2005 RECS

It is clear that the heating and cooling disruption statistics understate the level of energy affordability problems among low income households. While about 10 percent of households experience space heating disruptions, almost half of households reduce spending for basic necessities and over 20 percent of households have threats of service termination.

The 2005 RECS also asked low income survey respondents questions related to the health and safety dimensions of energy insecurity. Table 6.53 presents data from the 2005 RECS on the health and safety elements of energy affordability problems for low income households. For each type of health and safety problem, the table shows the percent of low income households indicating how often they experienced each type of problem. Table 6.53 shows that 26.0 percent of low income households had at least one type of health and safety problem in the preceding 12 months. The most commonly reported type of problem is "closing off part of home." However, close to 10 percent of low income households report experiencing each type of problem.

Table 6.53. Health and safety energy affordability problems in the preceding 12 months for low-income households in 2005

Health and Safety Problem	Almost Every Month	Some Months	1 or 2 Months	Never
Close off part of home	4.6%	6.4%	2.4%	86.6%
Keep home at unsafe temperature	1.8%	4.1%	2.5%	91.6%
Leave home for part of the day	1.0%	4.2%	3.6%	91.2%
Use stove or oven for heat	0.7%	4.9%	4.5%	89.9%
ANY PROBLEM	6.3%	12.4%	7.3%	74.0%

Source: 2005 RECS

Key findings from the exploratory analysis of the 2005 RECS energy affordability survey questions include:

- Incidence – The data show that over two-thirds of low income households faced some type of Energy Insecurity during 2005.

- Overlap – Some households faced only one type of problem; but many others experienced multiple problems during the year.

The exploratory study also examined how energy affordability problems varied geographically and demographically. The exploratory study found that the factors most associated with differences in the incidence rates for energy affordability problems were Census Region, Poverty Level, Vulnerability Group, and Residential Energy Burden Group. Findings included:

- Census Region – Low-income households in the Northeast and Midwest Census Regions have lower rates of heating and cooling interruptions than those in the other Census Regions. However, the incidence of other financial energy insecurity and health and safety problems is about the same in all Census Regions.

- Poverty Group – Households with incomes at or below the 100 percent of the poverty income guidelines have the highest rates of heating and cooling service interruptions, other financial energy insecurity, and health and safety problems.

- Vulnerability Group – Elderly households have lower rates of heating and cooling service interruptions, other financial energy insecurity, and health and safety problems than other types of households.

These findings were based on a multivariate analysis of the data to control for multiple factors at the same time.

6.5 DEFINING HIGH ENERGY USE AND HIGH ENERGY BURDEN

WAP regulations refer to prioritization of households with high energy use and high energy burden. However, the regulations do not furnish guidance with respect to the definition of either of those terms. In addition, the joint purposes of WAP would suggest that the best targets for the program are those households that have both high usage and high burden. Households with high usage tend to have the greatest energy saving potential and households with high burden can gain the greatest affordability benefits from reductions in their energy use.

One possible approach for defining priority households is to use the RECS data to identify households that are both high usage and high burden. For illustrative purposes, a simple model is presented in the tables that follow. The model includes:

- High Usage – Defining high usage households as those that are in the top quartile in terms of source energy use. Table 6.43 shows that 25 percent of low-income households consume 210.7 or more source MMBtus.

- High Burden – Defining high burden households as those that are in the top quartile in terms of energy burden. Table 6.1 shows that 25 percent of low-income households have energy burden of 15.3 percent or more.

- High Priority Households – Defining high priority households as those that have both high usage and high burden.

Please note that this is merely an illustrative model for defining high priority households. Policymakers might choose to weight one of the two components - either usage or burden – higher than the other because they might determine that one goal is more important than the other. They might choose to focus on site energy instead of source energy because they believe that the Btu content of electricity will go down over time with increases in renewable sources of electricity. Or, they might choose to define priority households within each region of the country, rather than for the nation as a whole.

The RECS data show that about 10 percent of low-income households would be defined as high priority using the model outlined above. Table 6.54 shows how low-income households in different groups are distributed by Climate Zone, as follows:

- Climate Zone – The first column in the table lists the Climate Zone.

- Percent of Low-Income Households – The second column in the table shows how low-income households are distributed by Climate Zone; for example, it shows that 35 percent of all income-eligible clients are in the Moderate Climate Zone.

- Percent of High Usage Households – The third column in the table shows how high usage households are distributed; for example, it shows that – using the definition above – 29 percent of high usage households are in the Cold Climate Zone. This column shows that the distribution of high usage households is similar to that of all low-income households, except that only 3 percent of high usage households are in the Hot/Dry Climate Zone, compared to 11 percent of all low-income households.

- High Burden Households – The fourth column in the table shows how high burden households are distributed; for example, it shows that 30 percent of high burden households were in the Cold Climate Zone. This column shows that the distribution of high burden households is again similar to the distribution of all low-income households, with the exception of the Hot/Dry Climate Zone.

- Energy Priority Households – The last column in the table shows the distribution of the illustrative "high priority" households. The incidence of high priority households is a little higher than the incidence of low-income households in the Very Cold, Cold, and Moderate Climate Zones. The incidence is a little lower in the Hot/Humid Climate Zone. The incidence is much lower in the Hot/Dry Climate Zone where low-income households have lower energy use and burden than in the other Climate Zones.

Table 6.54. Percent of low-income households in energy priority groups in PY 2008 by climate zone

Climate Zone	Percent of Low-Income Households	Percent of High Usage Households	Percent of High Burden Households	Percent of Energy Priority Households
Very Cold Climate	8%	10%	8%	11%
Cold Climate	27%	29%	30%	33%
Moderate Climate	35%	38%	36%	37%
Hot/Dry Climate	11%	3%	5%	3%
Hot/Humid Climate	19%	20%	22%	16%
NATIONAL TOTAL	100%	100%	100%	100%

Source: Adjusted 2005 RECS

The findings by Census Region are very similar to the findings by Climate Zone (Table 6.55). The Northeast and Midwest Census Regions have a higher percentage of high priority households than they have of low-income households. For the West Census Region, the incidence of energy priority households is less than one-half the incidence of low-income households – 8 percent of priority households compared to 19 percent of all low-income households.

Table 6.55. Percent of low-income households in energy priority groups in PY 2008 by census region

Census Region	Percent of Low-Income Households	Percent of High Usage Households	Percent of High Burden Households	Percent of Energy Priority Households
Northeast	21%	22%	25%	29%
Midwest	24%	30%	25%	27%
South	36%	39%	41%	35%
West	19%	10%	10%	8%
NATIONAL TOTAL	100%	100%	100%	100%

Source: Adjusted 2005 RECS

Table 6.56 shows how low-income and priority households are distributed by housing unit type. Single family detached homes represent only one-half of low-income housing units, but about two-thirds of high usage households, and almost 60 percent of the energy priority households. In contrast, about 23 percent of low-income households live in large multifamily housing units, but only 10 percent of the energy priority households are in that housing unit type. However, this is one place where the RECS data limitations potentially mask energy need. Since the RECS does not collect energy usage data for multi-family buildings with central heating equipment, the RECS could be understating the number of high energy use and high energy burden households in large multi-family buildings.

Table 6.56. Percent of low-income households in energy priority groups in PY 2008 by housing unit type

Housing Unit Type	Percent of Low-Income Households	Percent of High Usage Households	Percent of High Burden Households	Percent of Energy Priority Households
Mobile Home	10%	11%	10%	8%
Single Family Detached	48%	67%	52%	59%
Single Family Attached	8%	7%	8%	9%
Small Multi-Family	11%	9%	14%	14%
Large Multi-Family	23%	5%	15%	10%
NATIONAL TOTAL	100%	100%	100%	100%

Source: Adjusted 2005 RECS

Table 6.57 shows how low-income and priority households are distributed by owner/renter status. Owners are only about one-half of low-income households, but are estimated by RECS to be close to two-thirds of energy priority households. (Note: It is important to realize that since the RECS does not collect heating energy usage for multi-family buildings with a central heating plant there is uncertainty about this finding.)

Table 6.57. Percent of low-income households in energy priority groups in PY 2008 by tenure

Tenure	Percent of Low-Income Households	Percent of High Usage Households	Percent of High Burden Households	Percent of Energy Priority Households
Owner	52%	69%	61%	65%
Renter	48%	31%	39%	35%
NATIONAL TOTAL	100%	100%	100%	100%

Source: Adjusted 2005 RECS

Table 6.58 shows that there are significant differences between the distributions of low-income households and energy priority households by poverty group. Households with income less than the poverty line are 43 percent of low-income households, but would be 75 percent of energy priority groups using this definition. This table illustrates that differential weighting of the two factors – energy usage and energy burden – has a significant impact on the outcome of targeting priority households.

Table 6.58. Percent of low-income households in energy priority groups in PY 2008 by poverty level

Poverty Level	Percent of Low-Income Households	Percent of High Usage Households	Percent of High Burden Households	Percent of Energy Priority Households
Less than 100%	43%	37%	85%	75%
100% to < 150%	33%	36%	12%	22%
150% to < 200%	19%	22%	3%	3%
200% or more	4%	5%	0%	0%
NATIONAL TOTAL	100%	100%	100%	100%

Source: Adjusted 2005 RECS

Table 6.59 shows how the targeting factors differ by vulnerable household group. Elderly households represent 38 percent of low-income households, but 47 percent of energy priority households.

Table 6.59. Percent of low-income households in energy priority groups in PY 2008 by vulnerability group

Vulnerability Group	Percent of Low-Income Households	Percent of High Usage Households	Percent of High Burden Households	Percent of Energy Priority Households
Elderly	38%	35%	47%	47%
Children (No elderly)	37%	53%	26%	35%
No elderly or children	25%	13%	27%	18%
NATIONAL TOTAL	100%	100%	100%	100%

Source: Adjusted 2005 RECS

This illustration showed that it is important for policymakers to carefully consider how to define energy usage and energy burden priorities; different definitions result in quite different households being targeted by the program.

6.6 PROGRAM IMPLICATIONS

This section of the report presents detailed information on low-income energy use, including energy consumption, expenditures, and burden. As with the other dimensions examined by this study, the

analysis documents the considerable diversity in the energy circumstances faced by different low-income households. Some had very modest energy bills, a low energy burden, and indicate that they do not face any apparent problems associated with energy use; others had high energy bills that consume a considerable share of their income and result in both affordability and health and safety problems. And, of course, low-income households are found all along the continuum between these two extremes. Since the program regulations focus on "increasing energy efficiency of dwellings owned or occupied by low-income persons, reducing total residential energy expenditures, and improving their health and safety" it seems appropriate to focus on the specific findings that speak to those issues.

- Energy Expenditures and Burden – Energy expenditures do not increase rapidly with income; households with income less than 100% of the poverty guideline had expenditures that are only 5 percent less than the average for all low-income households. These households have an energy burden that is more than 50 percent higher than the average for all households, and as a result, these households have the highest level of energy affordability and health and safety problems. Services delivered to these households will have the greatest impact on energy affordability and on health and safety.

- Regional Patterns – The analysis shows that both energy expenditures and energy consumption as expressed by source Btus was similar for all Climate Zones and Census Regions, with one exception. The Hot/Dry Climate Zone had lower energy expenditures and consumption than the other Climate Zones.

- High Consumption and High Burden – The program regulations allow grantees to prioritize households with high energy use and high energy burden, but they do not specify how those terms should be defined. This analysis used the RECS data to identify high priority households as those with energy use in the top quartile and energy burden in the top quartile. Using that definition, about 10 percent of all low-income households would be identified as high priority (i.e., high use and high burden). Using that definition, the analysis finds the following:

    - Housing Unit Type: Single family homes had a higher incidence of priority households than other housing unit types, and large multi-family homes had a lower incidence. However, there is some uncertainty about that finding because of the limitation of RECS data.

    - Income Level: The lowest income households would be the highest priority using the definition of priority households being those with both high energy use and high energy burden.

    - Vulnerability Group: Elderly households had a higher incidence of priority households than other demographic groups.

This analysis helps to characterize the energy consumption, expenditures, and burden of low-income households. However, it does not propose any specific policy for the WAP program; rather it offers different ways of looking at the low-income population and considering how their energy needs could be met through service delivery by the WAP.