Avista Low Income Needs Assessment

Final Report

Submitted by Evergreen Economics

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Overview of Study Objectives and Approach

Avista contracted with Evergreen Economics in July 2019 to estimate the size and composition of the population in Avista's Washington service territory that is eligible to receive benefits from one or more of Avista's Energy Assistance programs. Evergreen assessed the current program penetration rate, which is the number of households that have received energy assistance as a proportion of the total estimated number of eligible households within the service territory.

The following statewide energy assistance programs offered between 2015 and 2018 were included in the analysis:

- Low-Income Home Energy Assistance Program (LIHEAP) – federal grants for households below 125 percent of the federal poverty level (FPL)
- Low-Income Rate Assistance Program (LIRAP) – funded by tariffs
    - LIRAP Heat – same benefits as LIHEAP but extends up to 150 percent FPL
    - LIRAP Senior/Disabled Outreach – grants for seniors and/or those with verifiable disability between 151 and 200 percent FPL
    - LIRAP Emergency Share – emergency assistance that replicates Project Share
- Avista CARES – hardship/emergency assistance grants, distributed by social service agencies without established energy assistance funding
- Project Share – donation based, community fuel fund emergency assistance grants for those who have exhausted all other available sources
- MISC – assistance grants distributed by agencies

LIHEAP, LIRAP Heat, and LIRAP Senior/Disabled Outreach provide grants to low-income households with some variations in their income qualifications and benefits. Households may receive benefits from only one of these programs at a time. The remaining energy assistance programs do not have an income threshold, but rather offer grants to households facing hardship or at risk of disconnection from arrearages. These programs include LIRAP Emergency Share, Avista CARES, Project Share, and MISC.

Our analysis for this energy assistance needs assessment was split into four phases:

1. **Participants** – Identify and characterize the households that received some form of energy assistance from Avista between 2015 and 2018.
2. **Eligible Population** – Use Census microdata to estimate the total number of households served by Avista that are eligible for low-income energy assistance.

3. **Penetration Rate by Customer Segment** – Compare the characteristics of participants to the population of income-eligible households to determine whether there are any groups that have lower than average program penetration.
4. **Households at Risk of Disconnection** – Look for any patterns in arrearages across all households served by Avista to predict the likelihood of future arrearages, and thereby the risk of disconnection.

Summary of Key Findings

This section summarizes the findings that are presented in more detail in Section 3: Results. These are organized by research questions, which are enumerated below.

What is the current program penetration rate? How many eligible customers have not yet been served?

Between 2015 and 2018, we estimate that 21 percent of all Avista customer households that were eligible to receive low-income assistance within its service territory received energy assistance. The program penetration rate ranges from 0 percent in Franklin County to 24 percent in Spokane County. Note that the majority of households served by Avista are located in Spokane County, which also has the highest penetration rate for income-eligible households. The counties furthest from Spokane, which have a relatively small number of households served by the utility, also have the lowest penetration rate.

Are there any differences in program penetration by customer segment?

The LIHEAP program has a higher rate of program penetration among eligible households containing at least one person with disabilities, low-income households at between 51 and 100 percent of the federal poverty level (FPL), and households with very high energy burden (utility bills over 6.3 percent of household income). The LIHEAP program has a lower rate of program penetration among renters. Only 34 percent of Avista's LIHEAP recipients are renters, but renters make up 62 percent of the eligible population in the Avista Washington service territory, according to our analysis of US Census data for the region. The eligible population of renters includes a large number of households with college students. Renters have much shorter tenures than homeowners, which may make them more difficult to identify and serve with program outreach materials.

Is there any way to predict which customers are likely to experience hardship or are in need of emergency energy assistance to prevent disconnection?

Our models of customer arrearages identified some regional characteristics (by Census tract) that have a significant impact on an individual household's likelihood of arrearage. Households are more likely to experience an arrearage if they are located on a reservation, are in a region with a high proportion of households receiving food stamps/SNAP

benefits, or have children or seniors. Households are less likely to experience an arrearage if they are located in regions with a high proportion of limited English-speaking households or households with Supplemental Security Income (SSI).

1 Introduction

Avista contracted with Evergreen Economics in July 2019 to estimate the size of the population within its Washington service territory that is eligible to receive energy assistance. Specifically, our research estimates the number of low- and moderate-income households with gas or electric service, or with a combination of services. The results will be used to design energy assistance programs, targeted outreach approaches, and future research to determine energy assistance funding needs.

Approach

Our overall approach was to use Avista customer information system and billing data combined with US Census data to estimate the size of the eligible population and characterize it using the available data. Avista customer data contain a variable that indicates whether households have received a low-income grant, which allowed for analysis of participation in programs at the Census tract level. Combined, these data provide insight into the program penetration by geography and household demographics.

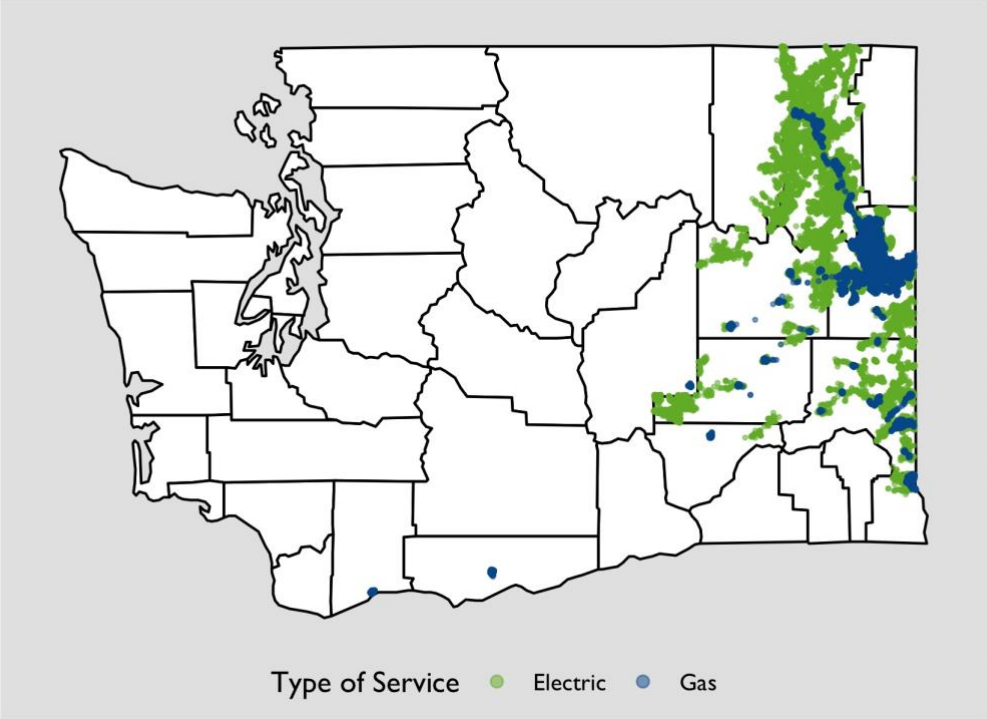
An important caveat of this analysis is that the Census data upon which we are relying to identify low-income program eligibility (e.g., up to 150 percent of the federal poverty level, or up to 300 percent in some cases) is not available at the household level, but instead for geographic areas such as county or Census tract.

Characterization of the low-income population and of high or low program participation levels is based on a review of characteristics such as demographic and housing stock across small geographic areas. Most program penetration and eligibility results are presented at the county level, though we used more granularity (e.g., Census tract) to best identify regions with low program penetration for future outreach and/or research efforts.

Service Territory

Avista serves a total of 286,863 households in the state of Washington, including 258,010 with electric and 174,864 with gas service. Figure 1 shows the location of every household in Washington that is currently receiving electric and/or gas service from Avista. The majority (n=213,286 or 74%) of Avista's residential customers are located in Spokane County, with another 18 percent in the bordering counties of Stevens, Whitman, and Lincoln. Avista provides gas service to a small number of households along the southern border of the state in Klickitat (n=1,074) and Skamania County (n=489).

Figure 1: Households in Avista's Washington State Service Territory



Source: Evergreen analysis of geocoded residential customers served by Avista as of July 22, 2019. Avista provided the latitude and longitude coordinates.

Energy Assistance Programs

Our analysis focused on Avista's energy assistance program offerings between October 2015 and September 2018, covering multiple program cycles since the introduction of Avista's current billing system in 2015. Table 1 provides a summary of Avista's energy assistance programs, including their eligibility criteria and types of benefits offered. The Low-Income Home Energy Assistance Program (LIHEAP) and Low-Income Rate Assistance Program (LIRAP) Heat and Senior/Disabled Outreach programs provide grants to low-income households. The remaining energy assistance programs do not have an income threshold, but rather offer grants to households at risk of disconnection due to hardship or arrearages. Note that we have excluded the Senior/Disabled Rate Pilot, Income Based Payment Program (IBPP), and Balance Management Arrangement Program (BMA) pilots from our analysis.[1]

[1] IBPP and BMA did not start until October 2018 and are not within the scope of this research; a separate impact and process evaluation is underway to address these two.

Table 1: Avista Energy Assistance Programs

Program	Eligibility Criteria	Benefits
Low-income home energy assistance program (LIHEAP)	125% FPL	Heating and cooling assistance
Low-income rate assistance program (LIRAP) Heat	150% FPL Not in LIHEAP	Energy assistance; mimics LIHEAP Customer cannot receive both LIHEAP and LIRAP Heat
LIRAP Senior/Disabled Outreach	151-200% adjusted FPL 60+ with fixed income or verifiable disability	Levelized billing based on the annual average $400 heating or $100 non-heating grant
LIRAP Emergency Share	No income qualification At risk of disconnection	Mimics Project Share, emergency assistance $350 max
Avista CARES	No income qualification Heat with Avista fuel	Hardship grant, distributed by agencies*
Project Share	No income qualification At risk of disconnection	Community fuel fund, Emergency/hardship grant $300 max per year
MISC	Varies by agency*	Hardship grant, distributed by agencies*
Senior/Disabled Rate Pilot	126-200% FPL 60+ with fixed income or verifiable disability Limited to four counties**	Rate discount
IBPP Pilot	10-50% FPL	Rate discount – fixed percentage discount, reduces bill to 6% of household income
BMA Pilot	IBPP participants with arrearages at the time of enrollment	One-time benefit covers 90% of arrearages if they make consistent payments towards the remaining 10% over one year

* The Agencies are non-profit service agencies, government agencies or churches whose purpose is other than energy assistance but who provide assistance in their course of helping individuals. These do not include the community action agencies (e.g. Spokane Neighborhood Action Partners – SNAP, Rural Resources, OIC, WGAP, Community Action Partnership, and Community Action Center) that typically administer energy assistance. .
** Pilot participants reside in Spokane, Lincoln, Stevens, or Ferry counties.

2 Methods

Our analysis for the energy assistance needs assessment was split into four distinct phases:

1. **Participants –** Identify and characterize the households that received some form of energy assistance between 2015 and 2018.
2. **Eligible Population –** Use Census microdata to estimate the total number of households served by Avista that are eligible for low-income energy assistance.
3. **Penetration Rate by Segment –** Compare the characteristics of participants to the population of income-eligible households to determine whether there are any groups that have lower than average program penetration.
4. **Households at Risk of Disconnection –** Look for any patterns in arrearages across all households served by Avista to predict the likelihood of future arrearages, and thereby the risk of disconnection.

2.1 Participant Data Analysis

This analysis will help to characterize the population that is currently being reached by Avista's energy assistance programs (i.e., a subset of the eligible population) by region, fuel service, and account characteristics.

We received the following data from Avista:

- Energy assistance program participation records by premise and account ID (between 2015 and 2018), including all available household demographics and income eligibility details;
- Utility account details for all participants and one full year of monthly billing records prior to receiving assistance from Avista; and
- Count of active residential accounts in Avista's service territory by fuel type (electric, gas, or combination) and geography (GIS coordinates or Census block preferred).[2]

We took a number of steps to clean the data to ensure that the data would support our analysis. This included combining lists of gas and electric customers to create a comprehensive list of individual households served by Avista along with the households' latitude and longitude coordinates. Other cleaning tasks included restricting billing data to only include accounts with one year of bills prior to program intervention. Table 2

[2] This is a complete anonymized extract of the customer information system, providing all available fields that are not personally identifying (i.e., omitting contact information).

summarizes the Avista data sources used in our analysis and the impact of our data cleaning procedures.

Table 2: Avista Data Sources and Cleaning

Data Source	Variables Provided	Date Range	Filters	Accounts (N retained of provided, if applicable)
Electric Service Accounts	Account ID, latitude and longitude	Current accounts	N/A	392,466
Gas Service Accounts	Account ID, latitude and longitude	Current accounts	N/A	378,085
Participant Accounts	Account ID, latitude and longitude	Current accounts with EA grant during study period	Duplicated account IDs, invalid coordinates	22,070 of 22,090
Grant Payments	Date and $ value of grant payments by program	October 2015 to September 2018	N/A	21,396
Utility Billing	Bill date, fuel type, rate code, cost and fuel usage	July 2014 to September 2018	Insufficient amount of pre-program bills*	14,495 of 21,381
Arrearages and Severances	Arrearage date, value and processing information	February 2015 to June 2019	N/A	9,358
Demographics	LIHEAP/LIRAP program demographic data	Program years 2016-2018	Duplicate or invalid account IDs	18,647 of 19,001

* Contains both gas and electric bills for customers with a variety of rate schedules, including deposits and payment arrangements. There were 16,372 customers with bills that span a full year, but we only retained the 14,495 customers with a full year of bills prior to first receiving an energy assistance grant.

In addition to these cleaning steps, some households were dropped due to a lack of overlap between data sources. For example, not all of the demographic data could be matched to customer accounts due to inconsistent account ID formats and duplicate account IDs. Of the 18,647 accounts with usable demographic data, 13,614 could be matched to current accounts with geocoded locational data (i.e., latitude and longitude coordinates). Between these restrictions and limitations on billing data (14,495 usable accounts), we identified a total of 6,164 accounts that had both demographic data and sufficient pre-participation billing history to assess energy burden. Overall, while the overlap of unique accounts was high within the accounts, billing, payments, and severances data (at least 96%), the overlap between these datasets and the demographic data was much more limited, with 70 percent of demographic account IDs appearing in

the accounts data. While there were some limitations posed by the data, the overlap between datasets was sufficient to provide a high-level summary of participation by program and Census tract, as well as allow for insights into the demographics and energy burden of LIHEAP participants.

2.2 Identifying the Income-Eligible Population

2.2.1 Census Microdata

Evergreen used U.S. Census data to identify the eligible population within Avista's service territory. While this public data source is only available at aggregated levels, it provides the best available characterization of Avista's service territory in absence of conducting costly primary customer research. The American Community Survey (ACS) is conducted by the US Census Bureau on an annual basis and provides detailed statistics about the social and economic needs of local communities. The ACS Public Use Microdata Sample (PUMS) files provide a wealth of information, with anonymized survey responses from individual housing units and weights to allow custom tabulation.[3] This trusted public data source provides an opportunity for Evergreen to clearly define and characterize the population of households eligible for participation in Avista's low-income programs in each region. However, it will not be possible to identify specific households that are eligible and that should be targeted for participation.

Table 3 provides a list of specific fields available in the 2013-2017ACS PUMS files that we utilized for the analysis. We calculated each household's income as a percentage of the federal poverty level (FPL), and then characterized the eligible population by tenure, primary language, and the presence of seniors. A separate PUMS file was utilized to identify which of these households include one or more disabled person, linked to the household data by a distinct household serial number.

[3] US Census Bureau. *American Community Survey Public Use Microdata Sample (PUMS) Documentation*. Accessed July 17, 2019. https://www.census.gov/programs-surveys/acs/technical-documentation/pums.html

Table 3: Data Utilized from the ACS PUMS

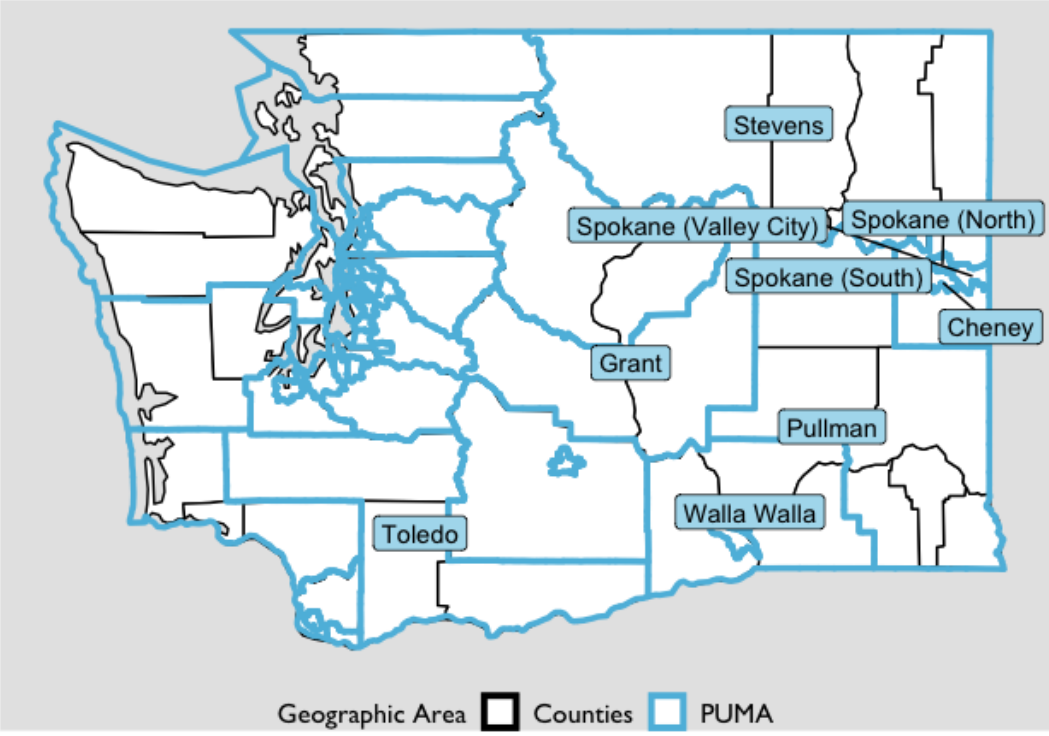
Field Name	Description	Intended Use
TYPE	Type of unit (to exclude institutional and group housing)	Estimate energy burden among utility rate payers
ELEP, GASP	Electricity and natural gas costs per month (option for N/A)	
FULP	Other fuel costs per month (option for N/A)	
NP	Number of persons in housing unit	Calculate household income as a % of FPL
HINCP	Household income	
ADJINC	Adjustment factor for income and earnings dollar amounts	
R60	Presence of persons 60 years and over in household	Characterize the population
DIS	Disability status	
SCHG	Current grade-level attending	
HFL	Home heating fuel	
HHL, LNGI	Household language, limited-English speaking household	
TEN	Tenure (own vs. rent)	
BLD	Units in structure	
MV	When occupant moved into this house/apartment	
YBL	Year when structure was first built	
FS	Indicator for receiving food stamps/SNAP	Estimate modified energy burden (i.e., public assistance benefits)
SSIP	Supplementary Security Income	
SSP	Social Security income	
PAP	Public assistance income	
HINS4	Indicator for Medicaid, Medical Assistance, or similar	

Geographic Adjustments

To maintain respondent privacy, the PUMS data extracts do not list Census tracts or block groups for each household; instead, the extracts list Public Use Microdata Areas (PUMAs). Figure 2 shows a map of the state of Washington with the ACS PUMAs outlined in blue and counties outlined in black. PUMAs are designed to follow county boundaries, with each area representing at least 100,000 people. Spokane County is split into four PUMAs

(East Central/Cheney, North Central, Outer/Valley City, and South Central), which enabled Evergreen to report on the variation in population density, program eligibility, and needs across these four regions of the county. The other counties in Avista's service territory have been grouped with bordering counties to create PUMAs that span a relatively large geographic area. For instance, the Toledo PUMA includes some Avista gas customers from Klickitat and Skamania County, but also includes all of Lewis County.

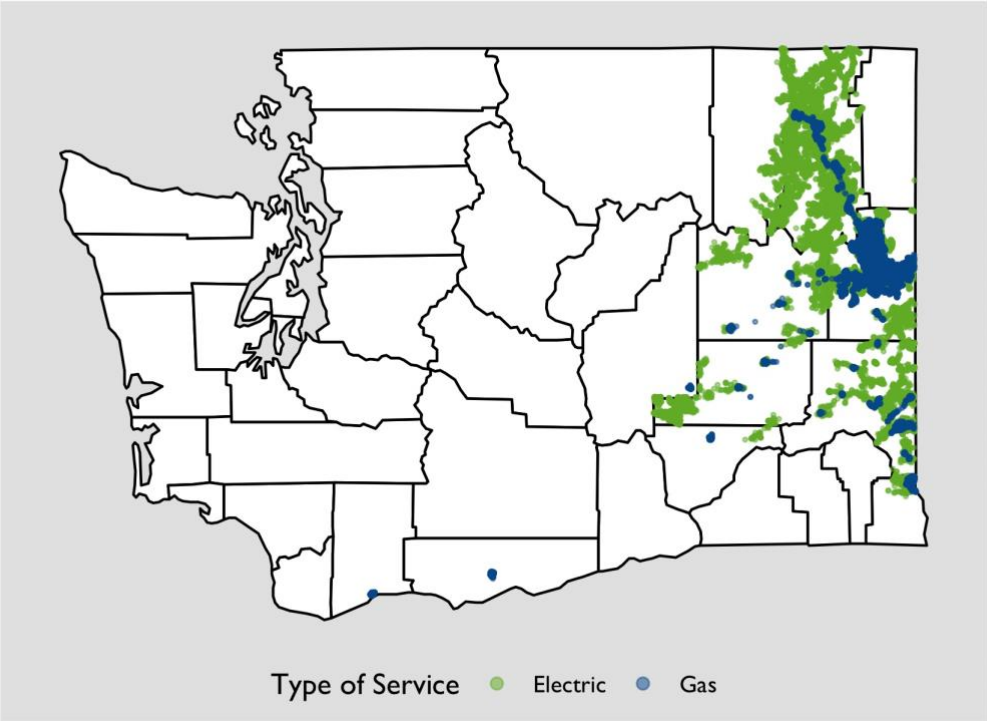
Figure 2: Washington State Public Use Microdata Areas (PUMAs)



Source: Washington State Office of Financial Management, 2010 Census GIS Shapefile https://www.census.gov/programs-surveys/geography.html

Figure 3 shows the location of every household in Washington State that is currently receiving electric and/or gas service from Avista. This data was used as the basis for our count of total households in Avista's Washington service territory.

Figure 3: Households in Avista Washington State Service Territory by Fuel Type



Source: Evergreen analysis of geocoded residential customers served by Avista as of July 22, 2019. Avista provided the latitude and longitude coordinates.

Evergreen used PostGIS and R software to overlay the geographic boundaries of the Washington service territory with the sampling regions of the public data (i.e., Census tract, PUMA, county). This step is critical in tabulating the Avista customer base, eligible population, and low-income program participants within comparable geographic regions.

We assembled a master database to combine our estimates of the eligible population from each of the PUMAs with the data from Avista's low-income programs, accounting for differences in geographic boundaries for GIS mapping and side-by-side comparisons. This allowed us to compare and contrast the PUMS estimates for the population of residential households receiving electric and/or gas service by region to the total number of residential service accounts in Avista's customer database. In regions where Avista is the primary utility service provider, these two counts closely align.

After we adjusted our estimates of the total population to focus on Avista's Washington service territory, we compared our estimates of the eligible households in each region against the number of program participants to determine the current program penetration.

2.2.2 Linear Regression Modeling

We developed and estimated statistical regression models to explain the variation in household income-eligibility across PUMAs, and what characteristics (that we may also observe at the tract and county level) might predict higher or lower rates, holding all other variables constant.

The final set of explanatory variables included in the regression models are a subset of the variables shared across data sources (i.e., PUMS vs. Census data at the tract level) and were selected based on their incremental relationship to the respective dependent variable.[4] Many pairs of variables within the Census data sets were highly correlated—that is, they have a strong positive or negative linear relationship. Because of this, they have the same or very similar relationship with the dependent variable, which can lead to problems in the estimation of the econometric model. For this reason, the final model specification shown in Equation 1 is limited to a subset of variables selected for their explanatory power and ease of interpretation. We explored a variety of model specifications, including the use of interaction terms.

We used the same model specification for LIHEAP and LIRAP Heat, which have income eligibility thresholds of 125 and 150 percent of the federal poverty level. All of the households that are eligible for LIHEAP will also be eligible for LIRAP Heat, but they are only allowed to participate in one program at a time.

[4] For instance, we tested a variation of the models to account for differences in urban vs. rural geography across PUMAs via the proportion of the population currently residing in metropolitan (as opposed to non-metro) regions. This metric was developed by the U.S. Department of Agriculture Economic Research Services (USDA ERS) by PUMA. The coefficient on this variable was small and statistically insignificant for all three eligibility models. Hence, it was not included in the final specification.

Equation 1: Linear Regression Model of Eligibility in PUMAs

$$\ln(Eligible_i) = a_i + b_1 \ln(LT35k_i) + b_2 \ln(GT100k_i) + b_3 AvgSize_i + b_1 \ln(SNAP_i) + b_1 \ln(Disabled_i) + b_1 \ln(LimitedEnglish_i) + e_i$$

Where:

$Eligible_i$ = Number of households eligible for assistance, in PUMA region *i*)

$LT35k$ = Number of households with annual income less than $35,000

$GT100k$ = Number of households with annual income greater than $100,000

$AvgSize$ = Average number of people in each household

$SNAP$ = Number of households receiving SNAP benefits

$Disabled$ = Number of households with one or more disabled persons

$LimitedEnglish$ = Number of non-English speaking households

$\ln()$ = Natural logarithm transformation

a, b = Coefficients to be estimated in the model

e = Random error term

Next, we used the coefficients estimated in the model along with tract-level data from the ACS to estimate the number of eligible households in each Census tract served by Avista, as shown in Equation 2.

Equation 2: Estimated Eligibility in Census Tracts

$$\ln(Eligible_c) = \hat{a}_i + \hat{b}_1 \ln(LT35k_c) + \hat{b}_2 \ln(GT100k_c) + \hat{b}_3 AvgSize_c + \hat{b}_4 \ln(SNAP_c) + \hat{b}_5 \ln(Disabled_c) + \hat{b}_6 \ln(LimitedEnglish_c)$$

$$Eligible_c = e^{\ln(Eligible_c)}$$

Where:

$Eligible_c$ = Number of households eligible for assistance, in Census tract region *c*

$\hat{a}, \hat{b}$ = Coefficients estimated in the regression model (of PUMAs)

$SNAP_c, AvgSize_c, \ldots$ = Characteristics of region *c*

e = Mathematical constant, the inverse of the natural log, $\ln()$

The LIRAP Senior/Disabled Outreach program extends LIRAP Heat assistance benefits to households between 151 and 200 percent of the FPL if they have at least one person who is over 60 years of age on a fixed income or with a verifiable disability. For this program, we adjusted the specification as shown in Equation 3 to split the low-income variable of "less than $35,000" into two separate categories, because the lowest income households with

incomes of "less than $20,000" will be eligible for LIRAP Heat or LIHEAP, while LIRAP Senior/Disabled Outreach will serve more households "between $20,001 and $35,000." We also added the number of households with seniors and removed the average household size from the explanatory variables.

Equation 3: Linear Regression Model of LIRAP Senior/Disabled Outreach Eligibility in PUMAs

$$\ln(Eligible_i) = a_i + b_1 \ln(LT20k_i) + b_1 \ln(BT20k35k_i) + b_2 \ln(GT100k_i) + b_3 AvgSize_i + b_1 \ln(SNAP_i) + b_1 \ln(Seniors_i) + b_1 \ln(Disabled_i) + b_1 \ln(LimitedEnglish_i) + e_i$$

Where:

$Eligible_i$ = Number of households eligible for assistance, in PUMA region i

$LT20k$ = Number of households with annual income less than $20,000

$BT20k35k$ = Number of households with annual income between $20,001 and $35,000

$GT100k$ = Number of households with annual income greater than $100,000

$SNAP$ = Number of households receiving SNAP benefits/food stamps

$Seniors$ = Number of households with one or more persons over 60 years

$Disabled$ = Number of households with one or more disabled persons

$LimitedEnglish$ = Number of non-English speaking households

$\ln()$ = Natural logarithm transformation

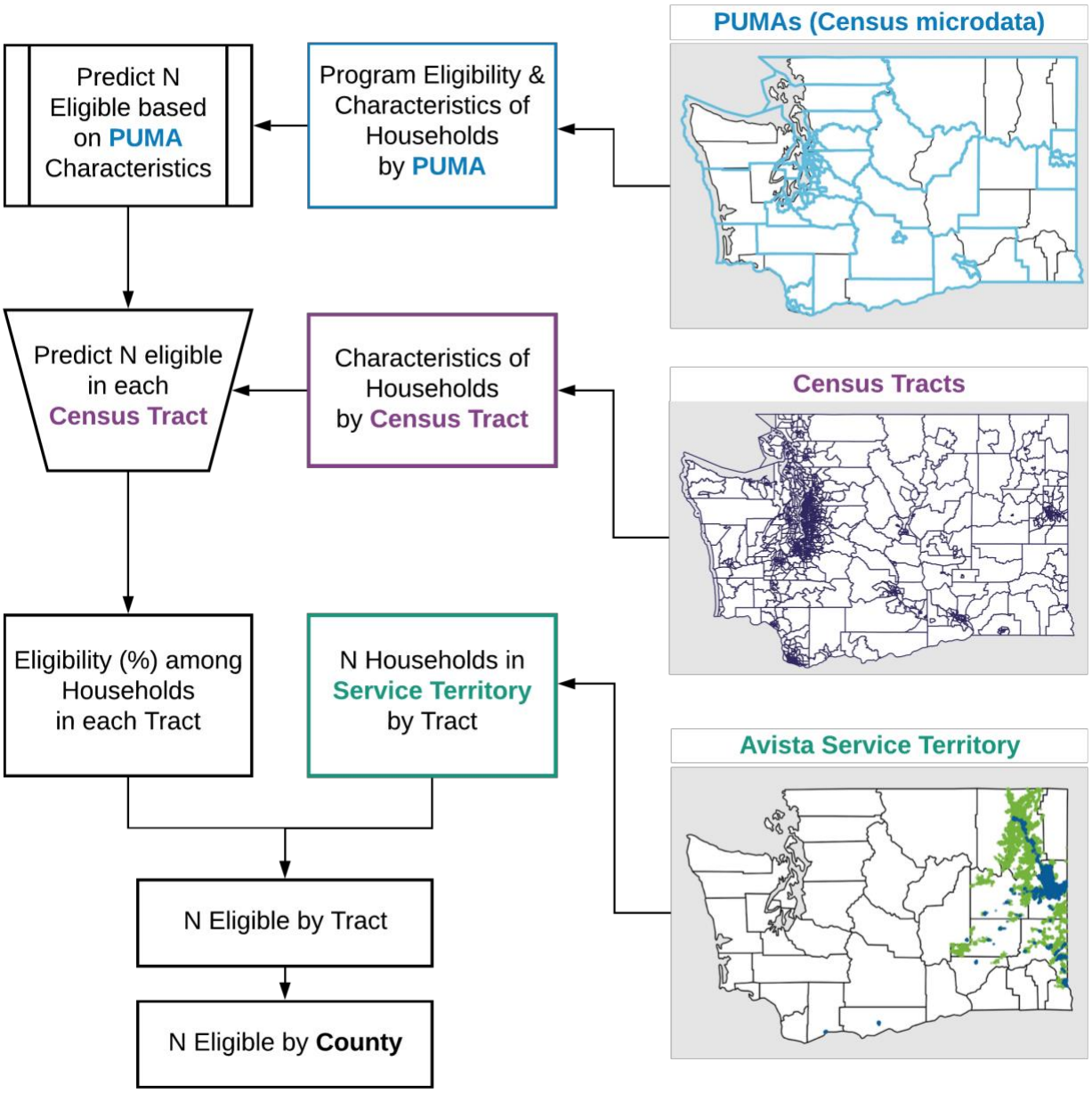
a, b = Coefficients to be estimated in the model

e = Random error term

Figure 4 provides a flow chart summarizing our approach, including the three distinct data sources (on the right). The final result of this analysis yielded estimates of the population of eligible households in the state of Washington by county that receive electric and/or gas service from Avista.[5]

[5] Tract level estimates for the number of eligible households were then capped at a set proportion of the total population of households within each tract; this cap is based on reported household counts of each tract. For LIHEAP, estimates will not exceed the proportion of households earning less than $50,000 per year. For LIRAP Heat, this was extended to households earning less than $75,000 per year. For LIRAP Senior/Disabled Outreach, estimates of the eligible population will not exceed the proportion of households with seniors.

Figure 4: Flow Chart of Methods for Estimating the Income-Eligible Population



2.3 Penetration Rate by Customer Segment

For this phase of the analysis, we defined "participants" as households that received any form of energy assistance, such as rate discounts, account credits/balance forgiveness, or emergency/hardship grant funds between 2015 and 2018.

We compared the number of program participants (i.e., low-income energy assistance recipients) to our estimates of the income-eligible households in each region to determine

the current program penetration rate. Comparing this metric across regions, account characteristics, level of energy burden, and household demographics reveals household traits associated with significantly different rates of participation. The demographic data is limited to a subset of programs (LIHEAP and LIRAP) but has the potential to identify segments with lower than average program penetration (i.e., eligible but not receiving benefits) without the need for primary data collection.

We used ACS tables by county, tract, and Census block group to create GIS heat maps for each of the key characteristics associated with lower rates of participation. Unlike the disaggregated ACS PUMS, we can request tables with ACS aggregate population estimates broken out by individual characteristics (e.g., primary language) at a fine level of geographic granularity. These heat maps will enable program staff to better understand where the customer segments with lower than average program penetration are located.

The findings will highlight the populations found to have lower than average participation rates. This can be used to inform future outreach and message testing campaigns. It will be useful for sample design and targeting of any primary data collection activities in future phases of energy assistance research, which can dive deeper into program awareness, perceptions, and needs with primary data collection such as customer surveys.

2.4 Households at Risk of Disconnection

There are four energy assistance programs available to households experiencing hardships, which puts them at risk of disconnection. These programs include LIRAP Emergency Share, Avista CARES, Project Share and some MISC grants. Incidences of hardship may be more common among low- and moderate-income households, but there are no income qualifications for households to receive these types of energy assistance grants.

We developed and estimated statistical regression models to explain the likelihood that an individual household will experience an arrearage during the year, given what we know about their geographic region from the ACS data. The arrearage data for these models include all customers with arrearages and disconnections, regardless of whether they received energy assistance. We are not estimating the impact of energy assistance on arrearages; instead we are trying to look for patterns in arrearages that could be useful for identifying households at risk of future arrearages.

Equation 4 provides definitions for each of the four dependent variables we used to describe arrearages. The first two are the log-odds of any arrearage and the log-odds of a large arrearage over $250.[6] The last two dependent variables are the average arrearage amount (in dollars, $) and the average number of months spent in arrears during each year (12 months) of the study period. In each case, we regressed the dependent variable (D_1, D_2, D_3, or D_4) against the same set of independent variables shown in Equation 5 .

Equation 4: Definitions of the Four Dependent Variables

$$D_1 = \text{Log-odds of arrearage: } \ln\left(\frac{\Pr(Arrearage > 0)}{1 - \Pr(Arrearage > 0)}\right)$$

$$D_2 = \text{Log-odds of large-arrearage: } \ln\left(\frac{\Pr(Arrearage > 250)}{1 - \Pr(Arrearage > 250)}\right)$$

$$D_3 = \text{Average arrearage amount (\$): } \frac{\sum_{x=1}^{n} Arrearage_x}{n}$$

$$D_4 = \text{Number of months in arrears: } \frac{\sum_{x=1}^{n}(Arrearage_x > 0)}{n}$$

Note: Pr(Arrearage) is the number of customer service accounts that had an arrearage in a given year, relative to the total number of Avista customers within that Census tract.

The models for average arrearage amount (D_3) and months spent in arrears (D_4) were limited to the subset of the population that had at least one arrearage during the study period.

Equation 5 provides the full model specification for our linear models of arrearages. We explored a variety of model specifications, including the use of interaction terms, and selected these independent variables for their explanatory power and ease of interpretation.

The explanatory variables shown in Equation 5 were chosen for their expected relationship with a household's ability to pay bills on time (e.g., income, children). In addition to income and composition, we looked at proxies for fixed income households, where an occasional large seasonal bill may present more of a challenge, such as supplemental security income (SSI). We included an indicator for households with residents who speak limited English, mostly with the goal of identifying whether there is a statistically significant relationship.

[6] The log-odds transformation limits the predicted values to (0,1), which is important for predicting probabilities that should never fall below 0 percent or exceed 100 percent. Regression analysis requires an assumption that the underlying variables are normally distributed. In some cases, a variable will be normally distributed after the natural log transformation, even when the variable itself was not normal.

Our initial models did not include an indicator for being located on a reservation, but this was added after further investigation revealed a high correlation with arrearages. Reservation tracts are defined as tracts 53019940000 (eastern portion of Colville Reservation) and 53065941000 (Spokane Reservation). These tracts were identified geographically and validated by the high proportion with a Native American head of household (more than 50%, while the next highest tract has only 5%) according to the Census data.

Equation 5: Linear Model of Arrearages

$$D_i = a_i + b_1 GT100k_i + b_2 LimitedEnglish_i + b_3 Renters_i + b_4 Reservation_i + b_5 Children_i + b_6 Seniors_i + b_7 SSI_i + b_8 (Seniors_i * SSI_i) + e_i$$

Where:

D_i = Value of the dependent variable for Census Tract *i*

GT100k = Number of households with annual income greater than $100,000

LimitedEnglish = Number of non-English speaking households

SNAP = Number of households receiving SNAP benefits/food stamps

Renters = Number of households occupied by renters

Reservation = Indicator for whether Census Tract contains a Native American Reservation

Children = Number of households with one or more persons under 18 years

Seniors = Number of households with one or more persons over 60 years

SSI = Proportion of households recieving Supplemental Security Income

ln() = Natural logarithm transformation

a, b = Coefficients to be estimated in the model

e = Random error term

3 Results

3.1 Low Income Assistance

This section includes a characterization of all low- and moderate-income households in the region, an overview of the program eligibility models, current program penetration (i.e., number of participants relative to the full eligible population), and identification of groups with lower than average program penetration.

As a reminder, the three low-income energy assistance programs available to households throughout Avista's Washington service territory are LIHEAP, LIRAP Heat, and LIRAP Senior/Disabled Outreach.

3.1.1 Regional Summary

This section provides a high-level summary of the US Census Public Use Microdata Area (PUMA) regions in the state of Washington that contain households served by Avista.

Table 4 and Figure 5 shows the distribution of self-reported household incomes as a proportion of the federal poverty level (FPL) within each PUMA region. We ordered these regions by the number of households served by Avista (electric and/or gas). The three Spokane PUMAs contain 83 percent of all households served by Avista in Washington State. The Stevens County and Pullman PUMAs have the highest proportions of households below the FPL, with 22 percent and 19 percent of households having incomes below 100 percent FPL, respectively. The proportion of low- to moderate-income households varies across PUMAs, with households below 300 percent of FPL making up between 51 percent of households in Cheney City PUMA to 70 percent in Stevens County PUMA.

Table 4: Household Income Distribution by PUMA

Household Income as % FPL	PUMA Region								
	Spokane (South)	Spokane (North)	Spokane, Valley City	Pullman	Cheney City	Stevens County	Toledo	Walla Walla	Grant County
0-50%	6.0%	5.1%	4.6%	6.6%	3.9%	7.2%	5.1%	4.7%	4.7%
51-100%	10.1%	10.7%	8.4%	12.1%	8.0%	15.2%	11.2%	8.5%	10.7%
101-125%	5.6%	6.5%	5.2%	6.0%	4.9%	7.6%	5.6%	4.1%	6.4%
126-150%	5.7%	6.8%	5.7%	6.4%	4.1%	7.0%	5.6%	4.8%	6.3%
151-175%	5.0%	5.9%	6.2%	5.8%	5.3%	6.3%	6.1%	5.2%	5.7%
176-200%	5.1%	6.8%	6.3%	5.3%	4.8%	5.6%	6.6%	4.7%	5.8%
201-225%	5.1%	6.6%	4.8%	5.5%	5.6%	5.5%	5.3%	5.6%	5.9%
226-250%	4.8%	5.9%	5.6%	4.7%	4.7%	5.5%	5.9%	5.5%	5.4%
251-275%	4.5%	5.2%	5.2%	4.5%	5.3%	4.8%	5.4%	4.7%	5.3%
276-300%	3.2%	5.1%	4.2%	4.5%	4.2%	4.8%	5.0%	4.7%	4.8%
301+%	44.9%	35.4%	43.8%	38.6%	49.2%	30.5%	38.2%	47.5%	39.0%
N Households Served by Avista	64,005	60,727	56,894	45,573	31,663	26,030	1,562	339	73
% of Avista HH	22%	21%	20%	16%	11%	9%	1%	<1%	<1%

Source: These household income distributions are based on Evergreen analysis of the ACS PUMS for 2013 to 2017. The number of households served by Avista is based on Evergreen analysis of geocoded residential customers as of July 22, 2019.

Figure 5: Household Income Distribution by PUMA

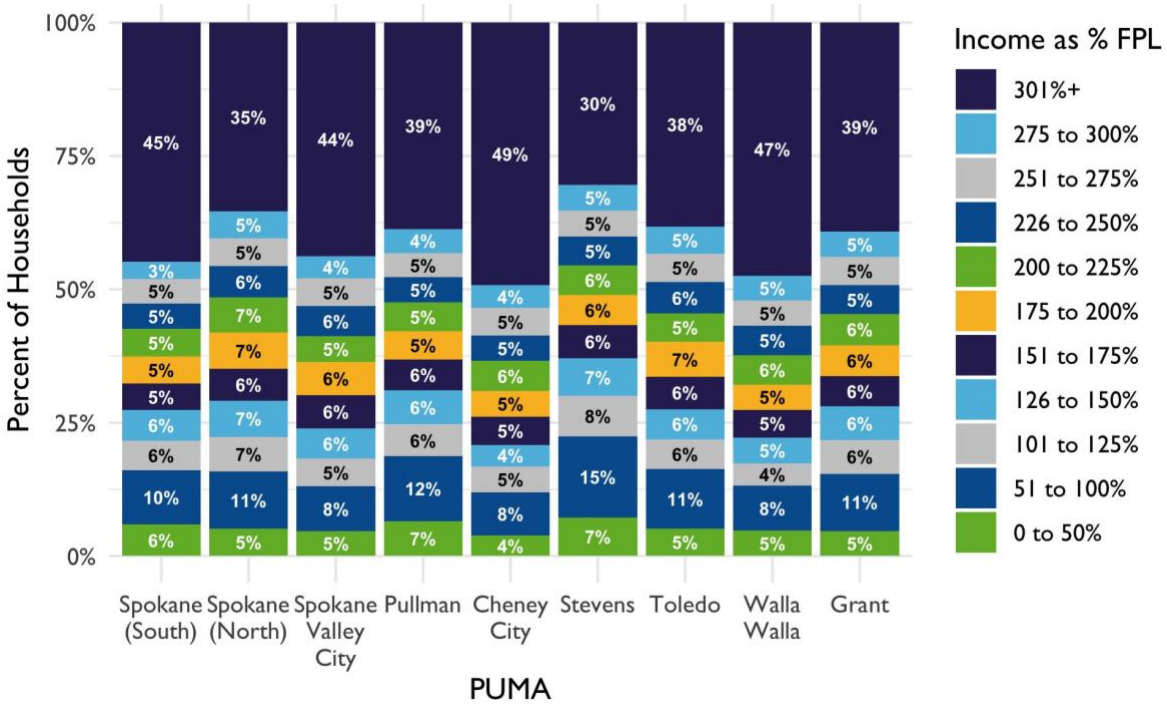


Table 5 provides a comparison of household characteristics by income group and PUMA region. In this table, we define low income as 0-150 percent of the FPL, moderate income as 151-300 percent of FPL, and high income as above 300 percent of FPL.[7] The main goal of this table is to provide a side-by-side comparison between the low-income households and the rest of the population within each region. For instance, across all PUMAs the proportion of households that use gas as their primary heating fuel is lowest in the low-income group and highest in the higher income group. In South Spokane, approximately 34 of low-income households use gas to heat their homes, compared to 48 percent of moderate income and 69 percent of higher income households. The proportion with gas heat varies substantially across PUMAs, likely due to a combination of factors such as building stock and climate. After the table, we present some of the most salient findings with data visualizations.

[7] The definition of low- to moderate-income is based on Avista's scope of work for the low income needs assessment, which listed 0 to 300 percent of FPL. We chose to define low income as 0 to 150 percent of FPL, consistent with the eligibility thresholds for LIRAP Heat.

Table 5: Household Characteristics by Region and Income Group

PUMA	Income Group	Households in Avista Territory	Household Characteristics						
			Renter	Electric Heat	Gas Heat	Limited English	Children	Seniors	Disabled
Spokane (South)	Low	18,847	69%	58%	34%	3%	28%	28%	40%
	Moderate	18,177	51%	46%	48%	3%	31%	32%	22%
	High	26,981	22%	26%	69%	1%	25%	37%	17%
Spokane (North)	Low	18,764	65%	50%	44%	3%	39%	33%	39%
	Moderate	21,073	35%	30%	65%	1%	34%	37%	30%
	High	20,890	17%	20%	76%	1%	24%	34%	23%
Spokane Valley City	Low	13,993	55%	54%	40%	1%	40%	34%	35%
	Moderate	18,270	39%	46%	48%	2%	34%	38%	31%
	High	24,631	18%	33%	63%	0%	29%	34%	23%
Pullman	Low	15,878	65%	67%	21%	10%	26%	28%	34%
	Moderate	13,060	38%	54%	32%	4%	29%	42%	33%
	High	16,635	20%	43%	47%	2%	22%	39%	21%
Cheney City	Low	6,827	49%	62%	21%	2%	34%	32%	38%
	Moderate	9,189	29%	48%	30%	0%	31%	44%	29%
	High	15,646	6%	41%	40%	0%	27%	43%	21%
Stevens County	Low	9,290	46%	58%	8%	2%	37%	45%	43%
	Moderate	8,298	19%	52%	10%	1%	28%	54%	37%
	High	8,442	10%	51%	15%	0%	20%	49%	28%
Toledo	Low	473	51%	73%	8%	3%	31%	42%	47%

PUMA	Income Group	Households in Avista Territory	Household Characteristics						
			Renter	Electric Heat	Gas Heat	Limited English	Children	Seniors	Disabled
	Moderate	535	26%	65%	15%	1%	29%	52%	37%
	High	554	17%	65%	13%	1%	20%	46%	28%
Walla Walla	Low	86	49%	76%	20%	9%	39%	36%	41%
	Moderate	102	36%	68%	24%	4%	41%	36%	32%
	High	151	16%	58%	34%	2%	25%	39%	21%
Grant County	Low	22	60%	88%	6%	10%	40%	31%	30%
	Moderate	24	38%	80%	9%	5%	37%	37%	27%
	High	27	17%	73%	16%	2%	23%	44%	23%

Source: Evergreen estimated the count of households in Avista territory by income group by applying the proportion of households within each income group (from analysis of the ACS PUMS) to the count of households in the service territory by PUMA (from Evergreen analysis of geocoded data provided by Avista). All of the household characteristics are based on analysis of the ACS PUMS 2013 through 2017.

Figure 6 shows the proportion of renters by PUMA region and income group. In every PUMA served by Avista, the percentage of households that rent their homes decreases as income increases. While the proportion of renters varies across PUMAs, the highest rate of renters was always found in the lowest income group.

Figure 6: Proportion of Renters by Region and Income Group

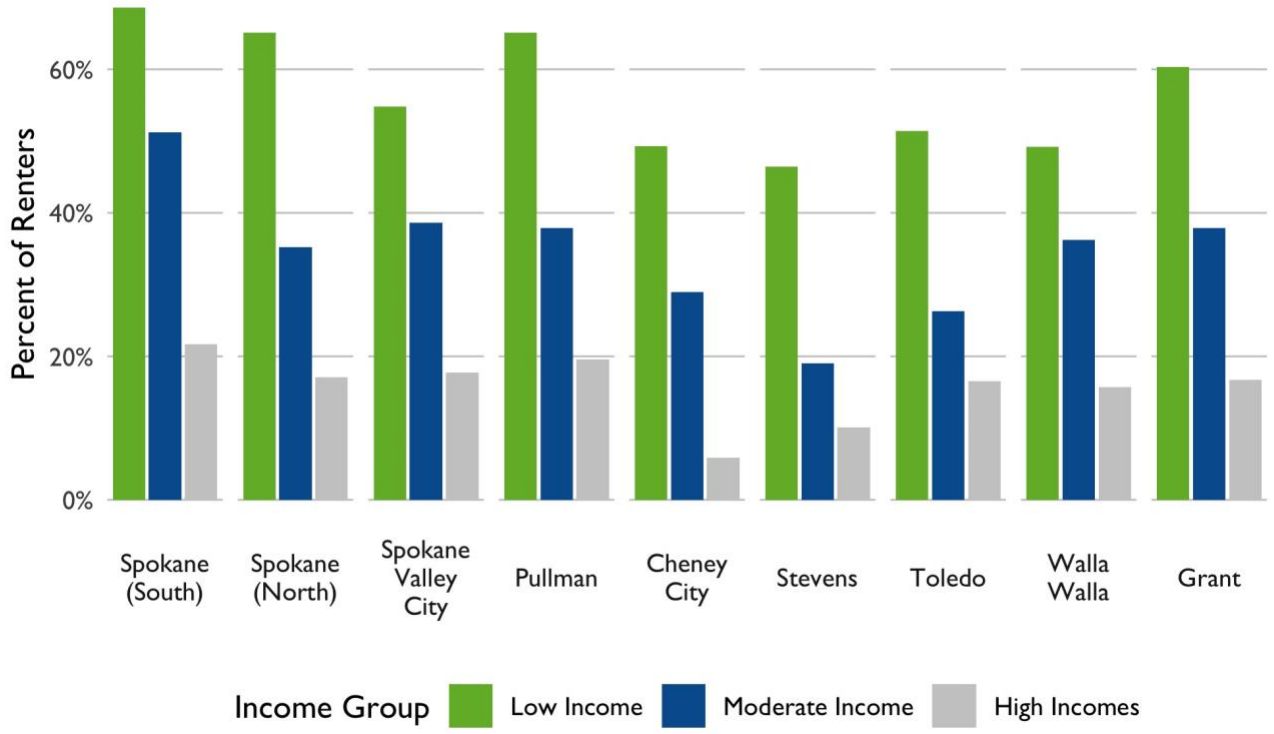
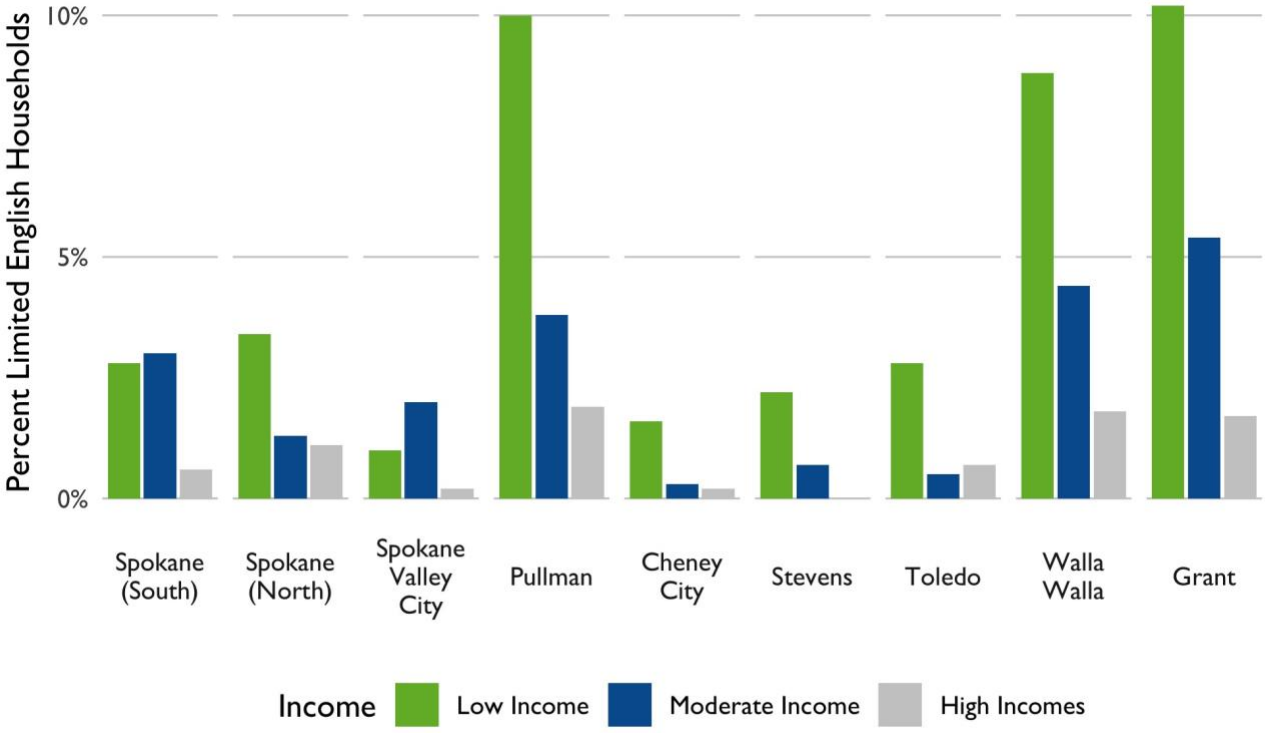


Figure 7 shows the proportion of households with limited English speakers by PUMA region and income group. The percentage of households with residents that speak limited English tends to be higher in low and medium income groups. The Grant County, Pullman, and Walla Walla PUMAs have much higher proportions of limited English-speaking households across all income levels than other regions.

Figure 7: Proportion of Limited English-Speaking Households by Region and Income Group



3.1.2 Eligible Population

We used US Census data to determine the number of households within each PUMA that are eligible to receive each type of low-income energy assistance offered by Avista. Next, we developed and estimated statistical regression models to explain the variation in household income-eligibility across PUMAs, and identify which characteristics (that we may also observe at the tract and county level) might predict higher or lower eligibility rates, holding all other variables constant. This section provides a summary of the regression coefficients and the resulting estimates of low-income program eligibility for each Census tract served by Avista. This section incorporates results from all three income-eligibility models: LIHEAP, LIRAP Heat, and LIRAP Senior/Disabled.

Table 6 provides the regression coefficients from the three program eligibility models, with bounds for a 95 percent confidence interval around each estimate; statistically significant coefficients are indicated with bold text. Additional outputs from each of the regression models can be found in Appendix A: Detailed Regression Outputs.

In the LIHEAP and LIRAP Heat models, a 1 percent increase in the number of households with incomes of less than $35,000 per year was associated with a statistically significant

increase in program eligibility of 1.22 and 1.14 percent, holding all else constant. The proportion of households receiving food stamp/SNAP benefits and average household size were also associated with a significant increase in the size of the eligible LIHEAP and LIRAP Heat population. Conversely, a 1 percent increase in the number of households with a disabled person was associated with a 0.26 percent decrease in both LIHEAP and LIRAP Heat eligibility. While this may seem counter-intuitive, keep in mind that we are already controlling for the number of households with incomes of less than $35,000 per year. If most households that would quality for LIRAP Heat and LIHEAP with a disabled person also make less than $35,000 per year, they would already be accounted for in the coefficient on income. The coefficient on disability is referring to its independent impact, holding all else constant.

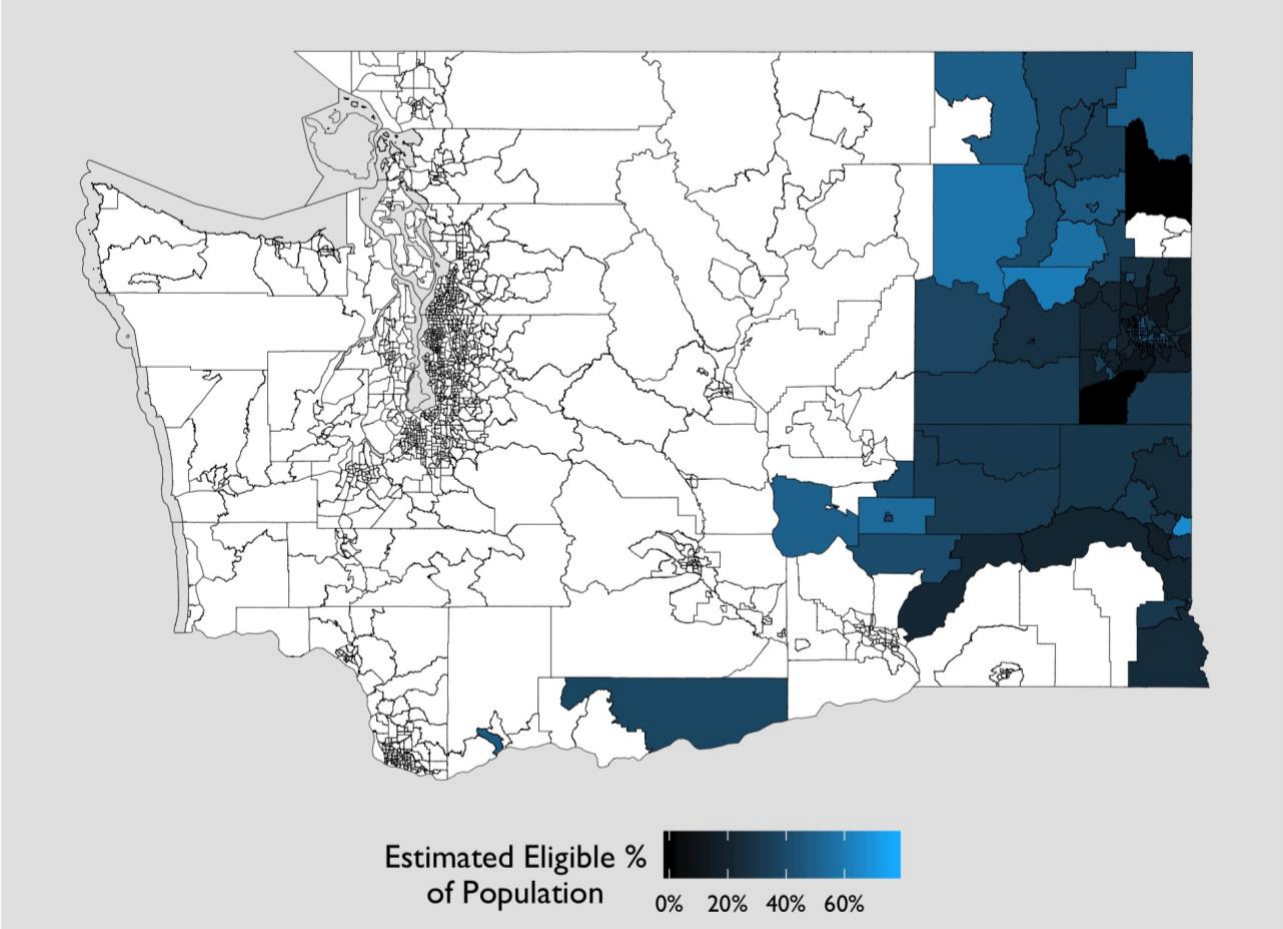
In the LIRAP Senior/Disabled Outreach model, we found that the number of households with less than $20,000 per year has an insignificant negative impact on eligibility. This is to be expected because households with the lowest incomes (below 150 percent of FPL), would be eligible for LIRAP Heat but not LIRAP Senior/Disabled Outreach. However, a 1 percent increase in the number of households with incomes between $20,001 and $35,000 is associated with a statistically significant 0.36 percent increase in the size of the eligible population. As expected, both the number of households with seniors and households with a disabled person were associated with statistically significant increases in eligibility of 0.67 and 0.55 percent, respectively.

Table 6: Eligibility Model Coefficients by Program

Variable	LIHEAP	LIRAP Heat	LIRAP Senior/Disabled
(Intercept)	-1.03 ± 1.15	-0.50 ± 1.00	**-2.65 ± 2.30**
ln(LT35k)	**1.22 ± 0.14**	**1.14 ± 0.13**	N/a
ln(LT20k)	N/a	N/a	-0.08 ± 0.20
ln(BT20k30k)	N/a	N/a	**0.36 ± 0.24**
ln(GT100k)	-0.01 ± 0.07	-0.04 ± 0.06	**-0.37 ± 0.15**
ln(Seniors)	-0.06 ± 0.17	-0.03 ± 0.14	**0.67 ± 0.35**
AvgSize	**0.35 ± 0.12**	**0.36 ± 0.11**	0.15 ± 0.26
ln(SNAP)	**0.09 ± 0.08**	**0.09 ± 0.08**	-0.09 ± 0.18
ln(Disabled)	**-0.26 ± 0.17**	**-0.26 ± 0.17**	**0.55 ± 0.35**
ln(LimitedEnglish)	-0.02 ± 0.03	-0.02 ± 0.03	0.005 ± 0.06

We applied these regression coefficients to American Community Survey (ACS) data by Census tract to produce the eligibility estimates shown in Figure 8; this includes all households that were eligible for one or more of the low-income energy assistance programs (LIHEAP, LIRAP Heat, or LIRAP Senior/Disabled Outreach). These proportions were then applied to the number of households served by Avista within each tract to ensure that our estimates are representative of Avista's actual Washington service territory. The proportion of households eligible for assistance by Census Tract ranges from 0 percent (black) to over 70 percent (bright blue); tracts shown in white do not contain any households served by Avista.

Figure 8: Heat Map of Household Eligibility for Income-Based Assistance by Census Tract



Source: Estimated eligible households are based on Evergreen's coefficient estimates from regression models of the ACS PUMS from 2013 to 2017, which were subsequently applied to the 2017 5-year Census ACS estimates by Census tract. The map itself includes Census tracts from the 2010 Census GIS Shapefile https://www.census.gov/programs-surveys/geography.html

3.1.3 Program Penetration

LIHEAP and LIRAP Heat have income eligibility thresholds of 125 and 150 percent of FPL, respectively. All of the households that are eligible for LIHEAP are also eligible for LIRAP Heat, but they are only allowed to participate in one program at a time. The LIRAP Senior/Disabled Outreach program extends energy assistance benefits to households at between 151 and 200 percent of FPL if they have at least one person who is over 60 on a fixed income or a verifiable disability.

Table 7 shows the number of households eligible for each of these low-income programs within Avista's Washington service territory by county; these are based on aggregations of our regression estimates by Census tract shown in Figure 8. This table also provides the number of unique households that received grant funding through at least one or more of these low-income programs between 2015 and 2018. Across all counties, 21 percent of the income-eligible households within Avista's Washington service territory have received energy assistance.

Table 7: Estimated Eligible Households and Grant Recipients by County

County	Estimated Eligible Households in Service Territory				Avista Households		% Receiving Assistance of Estimated Eligible
	LIHEAP	LIRAP Heat	LIRAP Senior/ Disabled	Total Eligible	Population	Grant Recipients	
Spokane	43,557	55,626	9,663	65,289	213,286	15,707	24%
Stevens	6,605	8,328	1,758	10,086	24,073	1,752	17%
Whitman	7,551	8,589	757	9,346	22,846	957	10%
Asotin	2,660	3,548	793	4,341	11,071	776	18%
Adams	1,973	2,536	334	2,870	6,743	569	20%
Lincoln	920	1,253	345	1,598	4,913	270	17%
Ferry	705	902	150	1,052	1,954	200	19%
Klickitat	261	316	93	409	1,074	19	5%
Skamania	154	201	33	234	489	4	2%
Franklin	91	117	14	131	339	0	0%
Grant	18	24	6	30	72	1	3%
Pend Oreille	3	3	0	1	3	0	0%
Total	**64,495**	**81,441**	**13,946**	**95,387**	**286,863**	**20,255**	**21%**

Source: Estimated eligible households are based on Evergreen's coefficient estimates from regression models of the ACS PUMS from 2013 to 2017, which were subsequently applied to the 2017 5-year Census ACS estimates by Census tract and

then aggregated to the county level. The population of households and grant recipients in the Avista service territory by County are based on Evergreen analysis of geocoded data provided by Avista in July 2019.

Figure 9 shows the proportion of households served by Avista that we predict are eligible for one or more of Avista's income-based energy assistance programs, ranging from 31 percent in Spokane County (dark blue) to 54 percent in Ferry County (bright blue). Figure 10 shows the proportion of these eligible households that have already received some form of energy assistance grant between 2015 and 2018. The program penetration rate ranges from 0 in Franklin County (dark orange) to 24 percent in Spokane County (light yellow-orange). Note that the majority of households served by Avista are located in Spokane County, which also has the highest program penetration rate for income-eligible households. The counties furthest from Spokane, which also have a relatively small number of households served by the utility, also have the lowest program penetration.

Figure 9: Heat Map of Household Eligibility for Income-Based Assistance by County

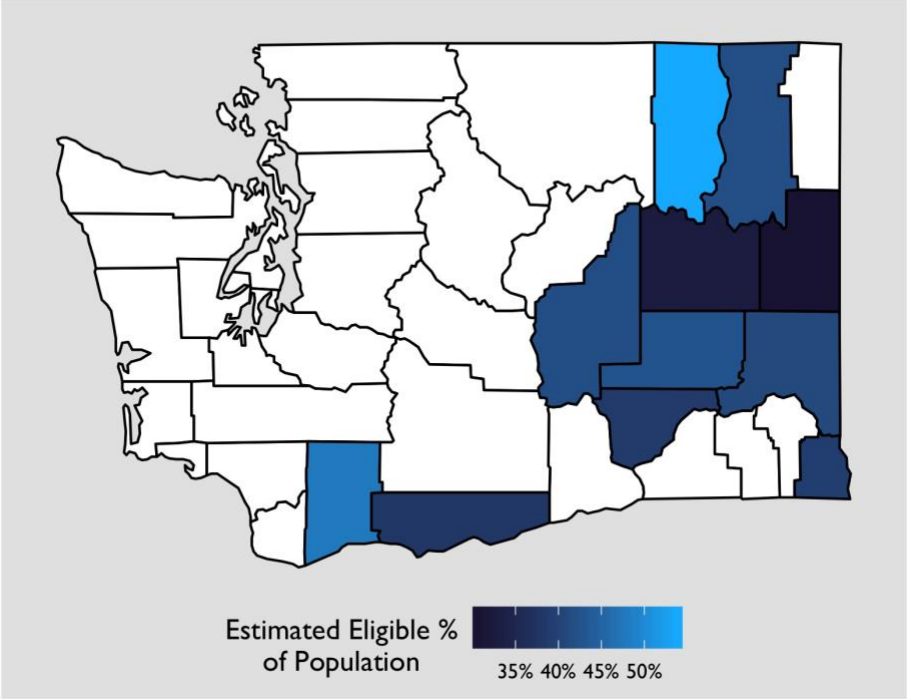
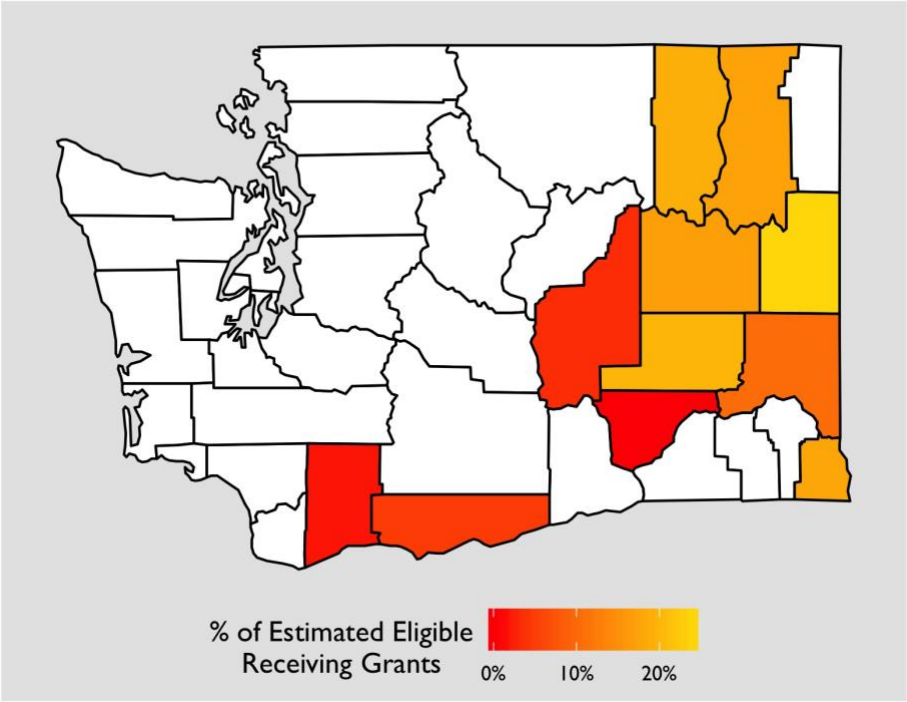


Figure 10: Heat Map of Low-Income Households Receiving Assistance by County



3.1.4 Program Penetration Rates by Segment

This section focuses on household eligibility and participation in low-income assistance programs. The goal is to identify any residential customer segments that have lower than average program penetration.

Detailed Avista household demographics were only available for LIHEAP and LIRAP participants. However, due to the lack of specificity between LIRAP Heat and LIRAP Senior/Disabled Outreach in the demographic data, we elected to restrict this analysis LIHEAP; this ensures a direct side-by-side comparison across the LIHEAP participant demographics and characteristics of the estimated eligible population for LIHEAP from the ACS PUMS.

Table 8 provides characteristics of households that participated in LIHEAP between 2015 and 2018 relative to the total population of eligible households in the region, based on the 2013 to 2017 ACE PUMS. If these two proportions are different, this suggests that the Avista program penetration rate is above or below average for that customer segment. For instance, 55 percent of Avista households receiving assistance from LIHEAP include at least one person with a disability, compared to 39 percent of households in the service territory that are eligible to participate; the LIHEAP program penetration rate is above average among households with disabled persons. These statistics may be useful for informing decisions around program marketing and outreach for groups that have

relatively lower participation rates. The percentage of participants with electric heating is nearly identical to the eligible population (59%).

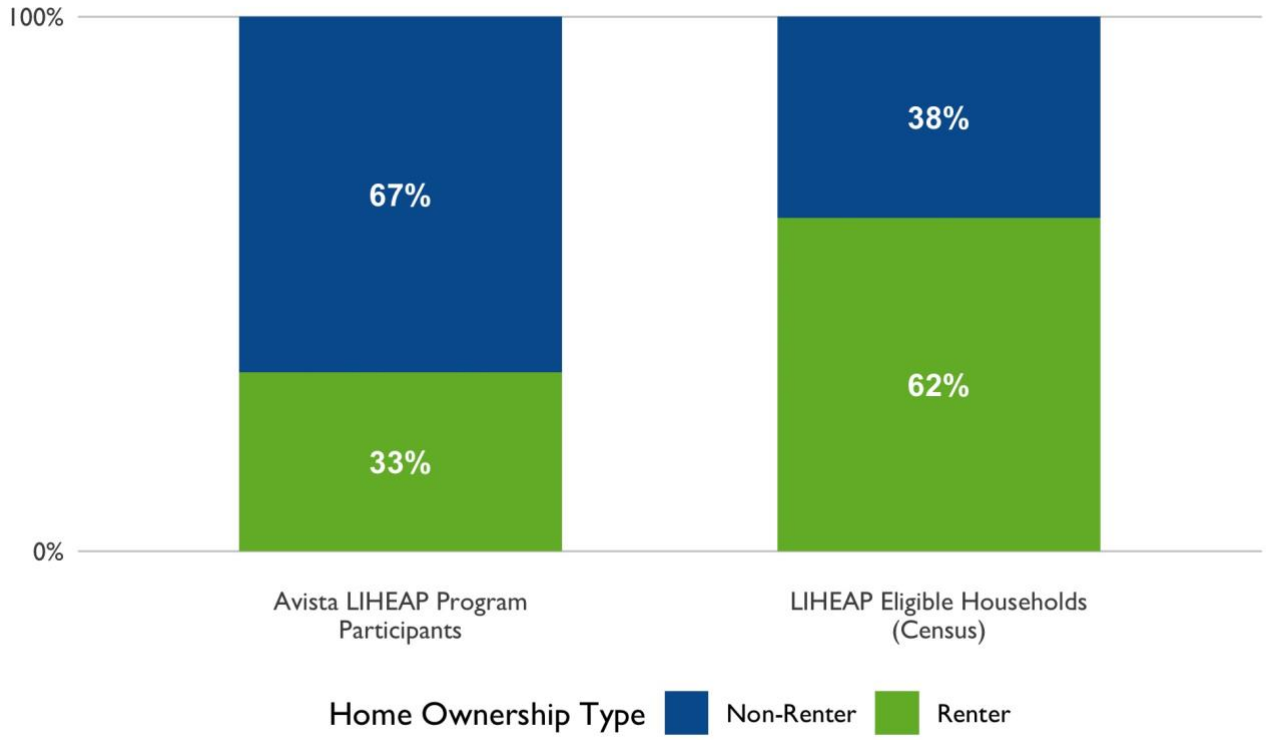
Table 8: Characteristics of Avista LIHEAP Participants versus Eligible Households

Household Characteristics	Avista LIHEAP Participants	Eligible Population
Renter	33.5%	62.3%
Electric Heat	58.5%	59.2%
Gas Heat	34.3%	29.7%
Children in Household	39.5%	34.3%
Seniors in Household	24.9%	30.9%
1+ People with Disabilities in Household	55.3%	38.5%
0 to 50% above FPL	28.7%	27.1%
51 to 100% above FPL	65.1%	47.2%
101 to 125% above FPL	6.2%	25.7%

Source: Characteristics of Avista LIHEAP participants are based on the grant payments and household demographics provided by Avista for program years 2016-2018. Characteristics of the eligible population are based on Evergreen analysis of ACS PUMS for 2013 to 2017.

Figure 11 shows that 34 percent of LIHEAP participants in Avista's Washington service territory are renters, but our analysis estimates that renters make up 62 percent of the eligible population in the service territory. The current LIHEAP program penetration rate is below average for renters. One possible explanation for this pattern is that multifamily residences have a significantly higher proportion of renters and tend to be smaller than single family homes. Smaller homes often have lower energy usage and thus smaller utility bills, reducing the motivation for customers to seek assistance. Keep in mind that our estimate of eligible households excludes institutional housing (e.g., college dormitories) and anyone else who does not pay their utility bills directly (e.g., utilities included in cost of rent). College students that pay rent and utility bills are included, so students that receive financial assistance from family or scholarships may be considered eligible, as this is not explicitly listed as a reason for disqualification from energy assistance.

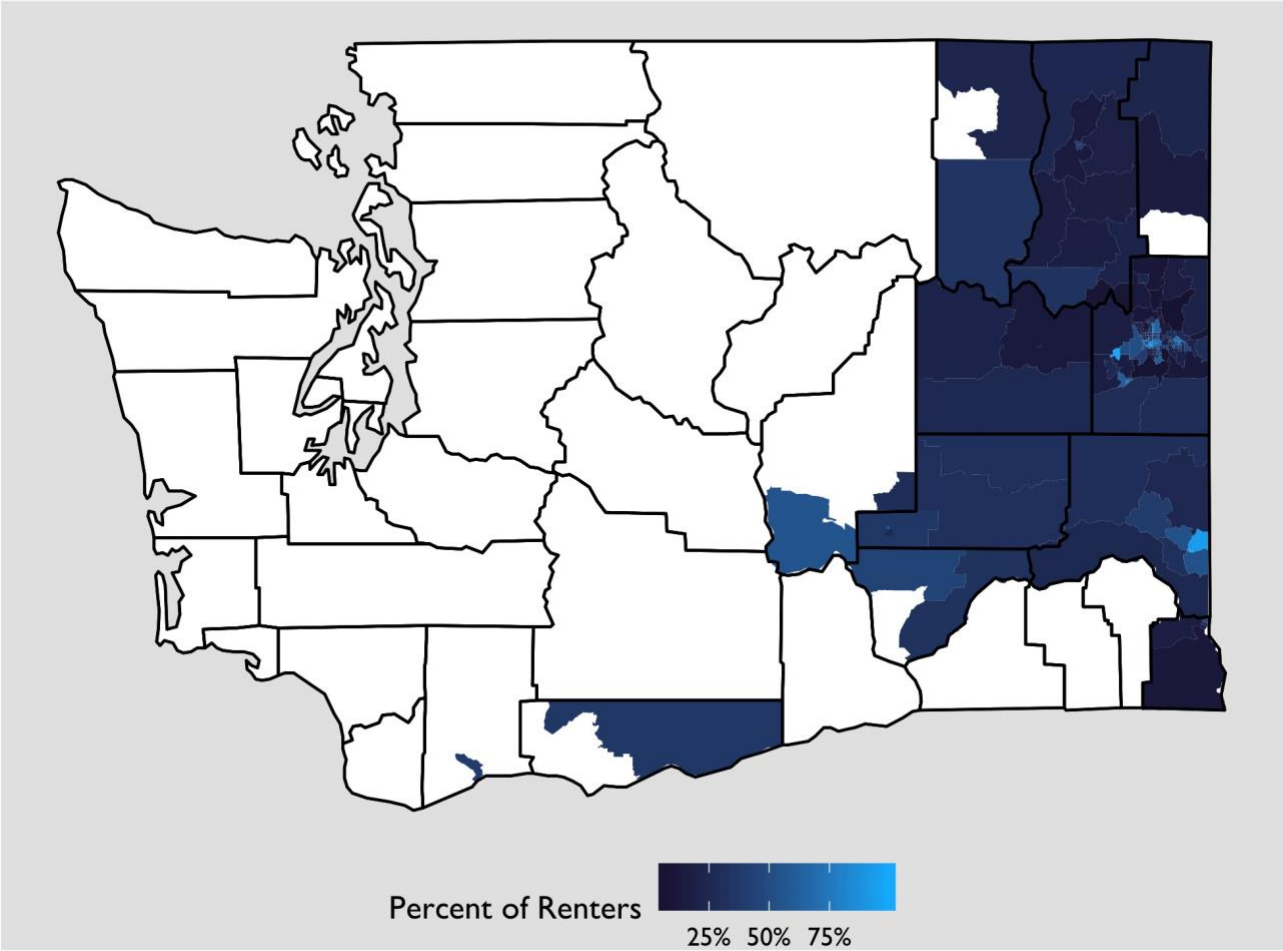
Figure 11: Participation and Eligibility Rate by Tenure and Fuel Service



Source: Characteristics of LIHEAP participants are based on the grant payments and household demographics provided by Avista for program years 2016-2018. Characteristics of the eligible population are based on Evergreen analysis of ACS PUMS for 2013 to 2017.

Figure 12 provides a heat map with the percentage of households that rent within each of the Census tracts served by Avista. The highest concentrations of renters are located around the cities of Pullman, Cheney, and Spokane, as well as Fairchild Air Force Base.

Figure 12: Home Rental Rate within Population by Census Tract

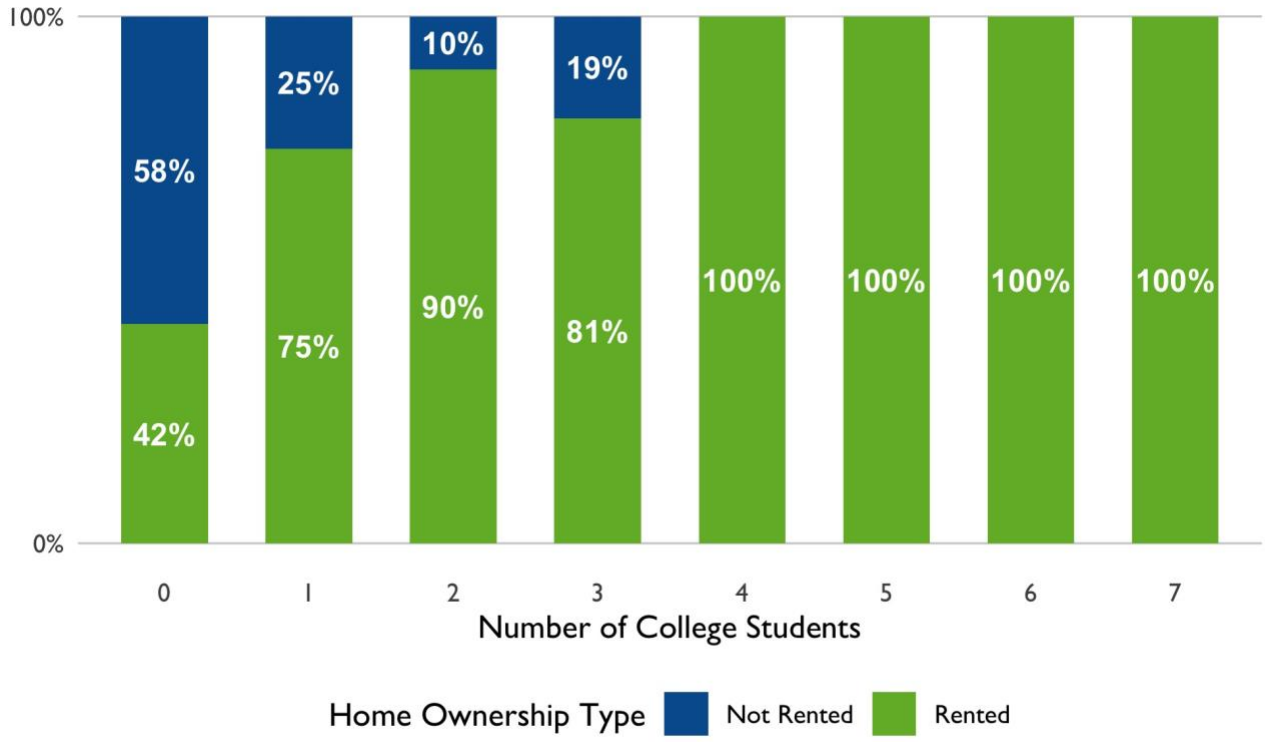


Source: Percent of renters is based on the 2017 5-year Census ACS estimates by Census tract. The map itself includes Census tracts from the 2010 Census GIS Shapefile https://www.census.gov/programs-surveys/geography.html

One possible explanation for the lower program penetration for renters is the high rates of rentals among households with college students. This is important because Avista serves the areas surrounding both the cities of Pullman and Cheney, where many students from Washington State University and Eastern Washington University reside.

Figure 13 shows the percentage of renters within the population of eligible households by the number of college students within the household. Around 41 percent of eligible households without any college students rent their home, compared to 75 to 100 percent of households with one or more college students.

Figure 13: Home Ownership within Eligible Population by Presence of College Students

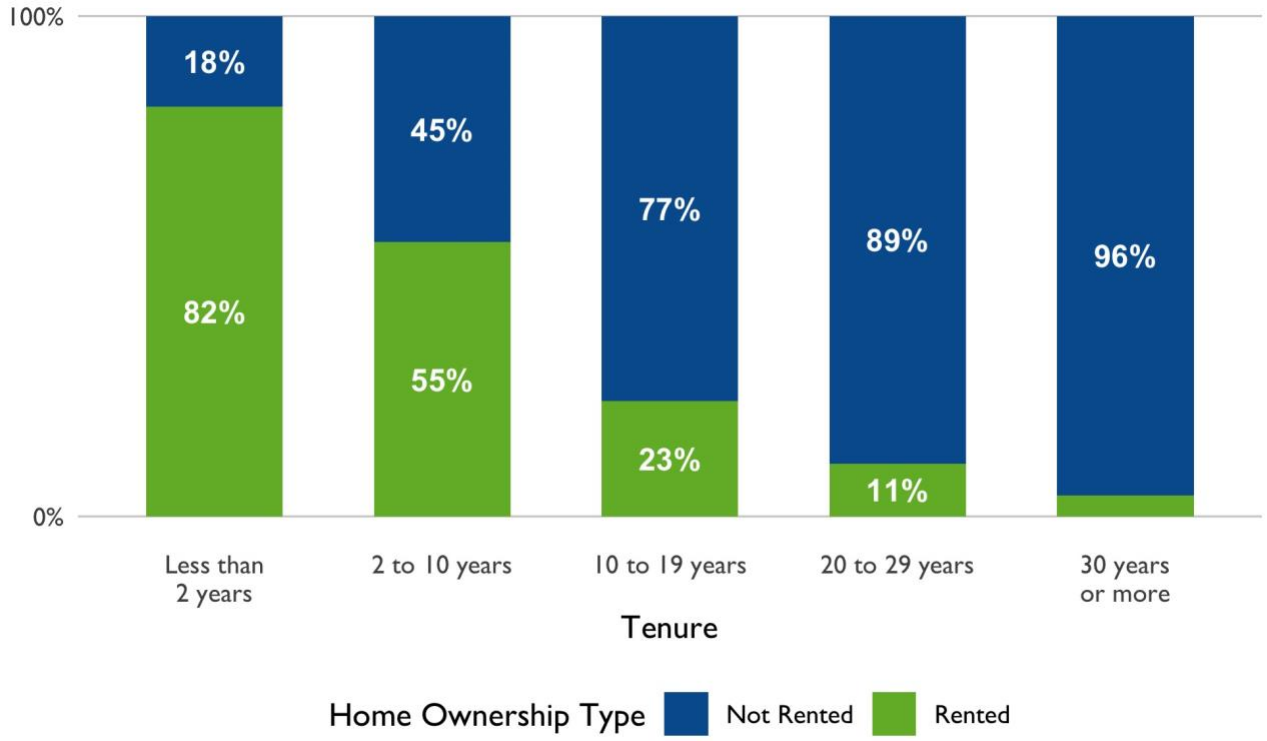


Source: Characteristics of the eligible population are based on Evergreen analysis of ACS PUMS for 2013 to 2017.

Another possible explanation for Avista's low penetration rate among renters is the short tenure of households that rent, instead of own, their homes. Figure 14 shows the percentage of renters within the population of eligible households by the number of years they have lived in the home. Among those households with the shortest tenure of 0 to 2 years, 82 percent are renters. The proportion of renters declines steadily as the tenure increases. It can take time for Avista and the agencies to identify households in its service territory that may be eligible, send marketing materials or other forms of program outreach, approve the application, and issue the energy assistance grants. Avista defines a "household" as a residential meter (i.e., home with utility service) and the associated customer (i.e., responsible party or ratepayer). If a participating customer moves to a new home, they will not automatically be enrolled in an energy assistance program. Such households may be less motivated to seek assistance if they know they are only temporarily in the home. Other barriers may include that renters are not sure if they will need their landlord's permission to participate in an energy assistance program, or may

feel that they are not in control of their energy bills and not pay as much attention to the bill or any promotional materials that come with it.

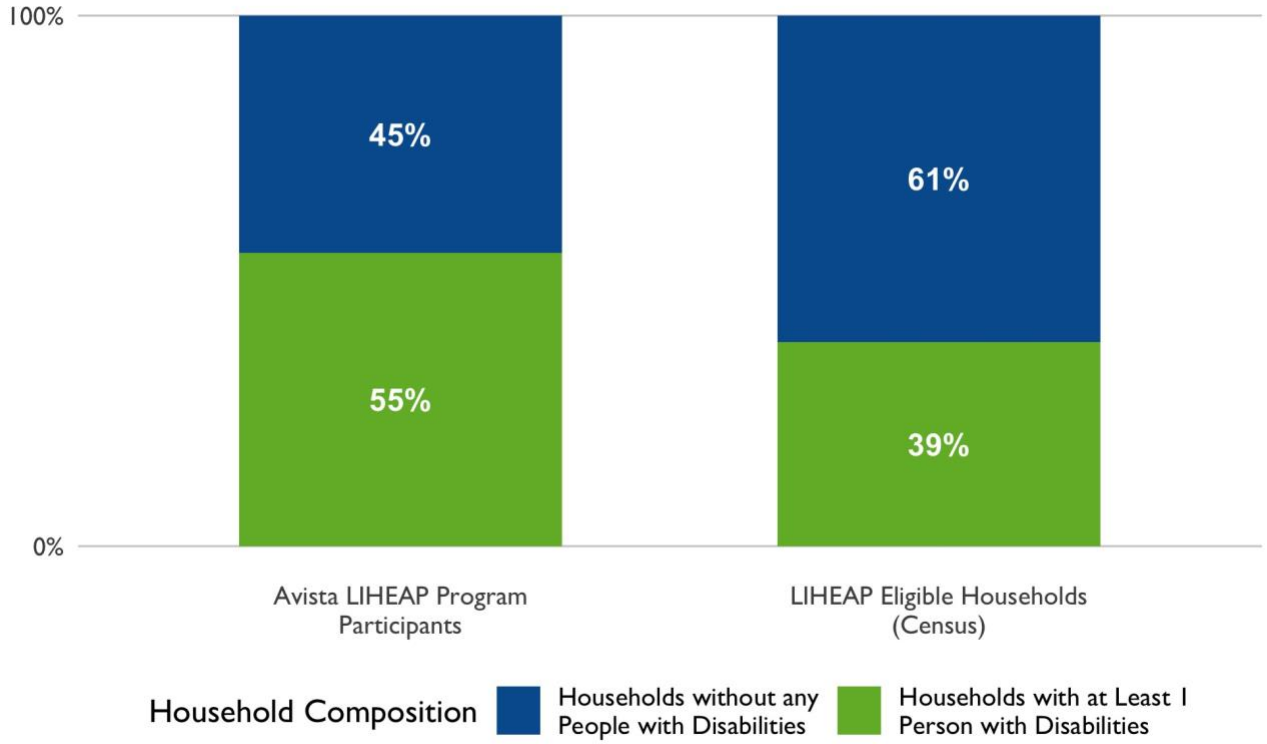
Figure 14: Home Ownership within Eligible Population by Tenure



Source: Characteristics of the eligible population are based on Evergreen analysis of ACS PUMS for 2013 to 2017.

Figure 15 shows that 55 percent of households participating in LIHEAP include one or more disabled person(s), but these households make up only 39 percent of the eligible population, according to our analysis of Census data for the region. Though households with disabled persons may be more likely than the general population to fall below the LIHEAP income threshold (125 percent of FPL), this will be reflected in both the program participants and eligible population; it does not explain the difference. The LIHEAP program penetration rate is higher than average among disabled households. This may be due to spillover of outreach for the LIRAP Senior/Disabled program into the LIHEAP and LIRAP Heat programs, which provide assistance for both disabled and non-disabled households at a lower income threshold.

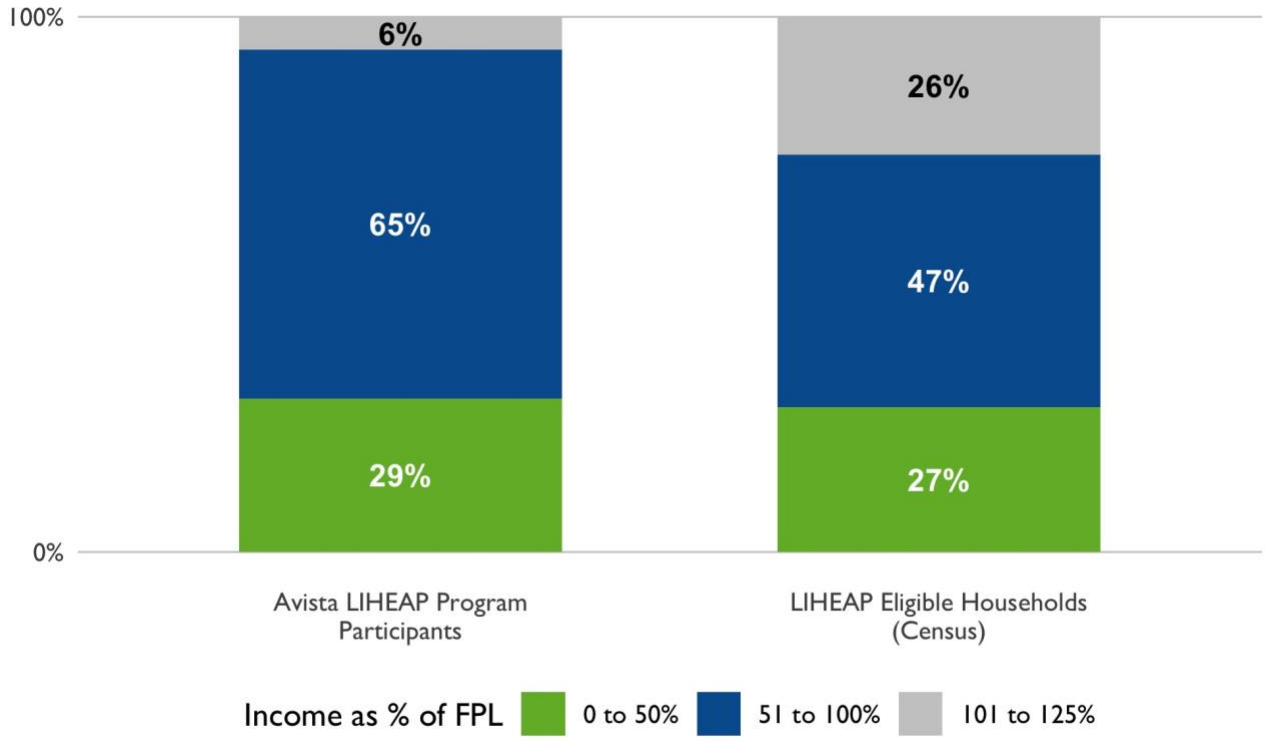
Figure 15: Enrollment Rate by Disability Status



Source: Characteristics of LIHEAP participants are based on the grant payments and household demographics provided by Avista for program years 2016-2018. Characteristics of the eligible population are based on Evergreen analysis of ACS PUMS for 2013 to 2017.

Figure 16 shows the distribution of household income as a percentage of FPL among households participating in LIHEAP versus the distribution of all eligible households in the region. The program penetration rate is above average among households with incomes between 51 and 100 percent of FPL (65% participating vs. 47% eligible) and below average among households with incomes between 101 and 125 percent of FPL (6% participating vs. 26% eligible). Sometimes more moderate-income households may not identify themselves as low-income and in need of assistance, either because they are unaware that they actually qualify, or do not want the stigma associated with receiving help.

Figure 16: Enrollment Rate by Household Income

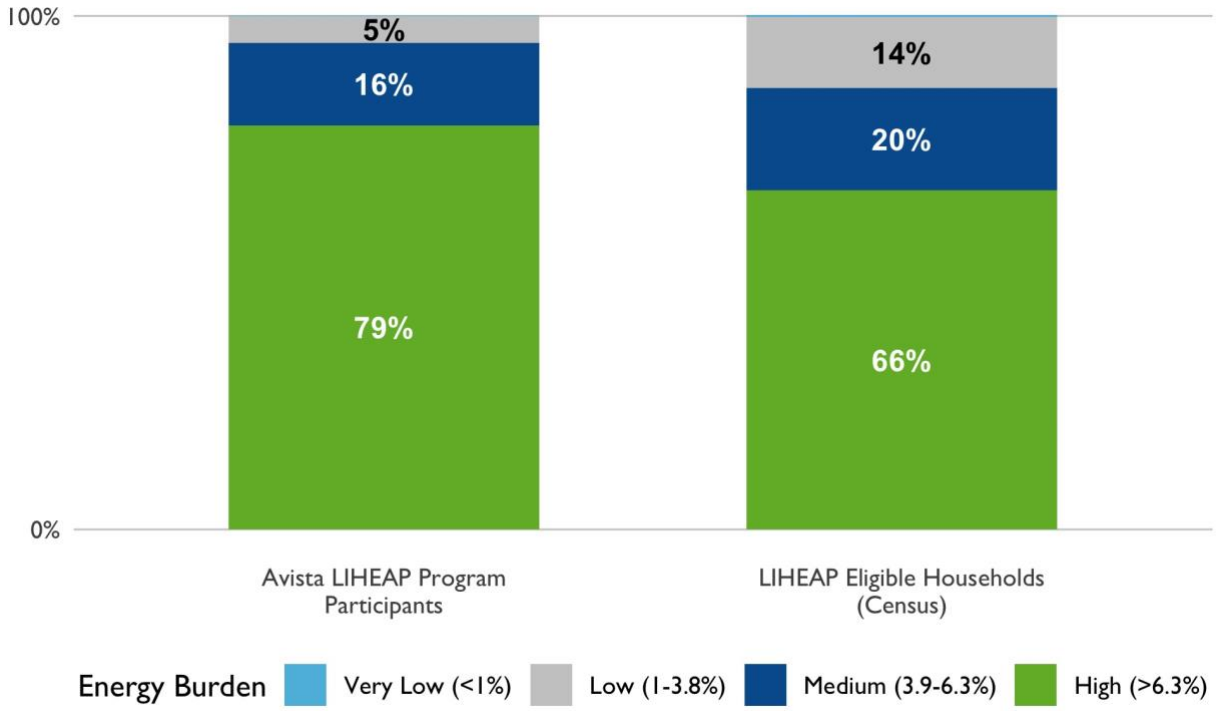


Source: Characteristics of LIHEAP participants are based on the grant payments and household demographics provided by Avista for program years 2016-2018. Characteristics of the eligible population are based on Evergreen analysis of ACS PUMS for 2013 to 2017.

We explored energy burden, which is the total cost of electric utility bills (and gas, where applicable) as a proportion of household income. This metric is commonly used to evaluate the financial need of low-income households. Please note that the Census estimates of energy burden are based on self-reported income and self-reported typical energy bill costs by fuel, while the energy burden of the Avista LIHEAP participants is based on verified household income as well as analysis of actual electric and gas utility bills for the preceding year.

Figure 17 shows the distribution of household energy burden (i.e., cost of utilities as a percentage of household income) among households participating in LIHEAP, at the time they first received energy assistance, versus the distribution of all households eligible for income-based assistance in the region. Avista has above average program penetration among households with very high energy burden (energy costs greater than 6.3 percent of their household income) and below average program penetration among all other groups. This suggests that Avista's current marketing and outreach efforts are successfully reaching those households with the highest level of need.

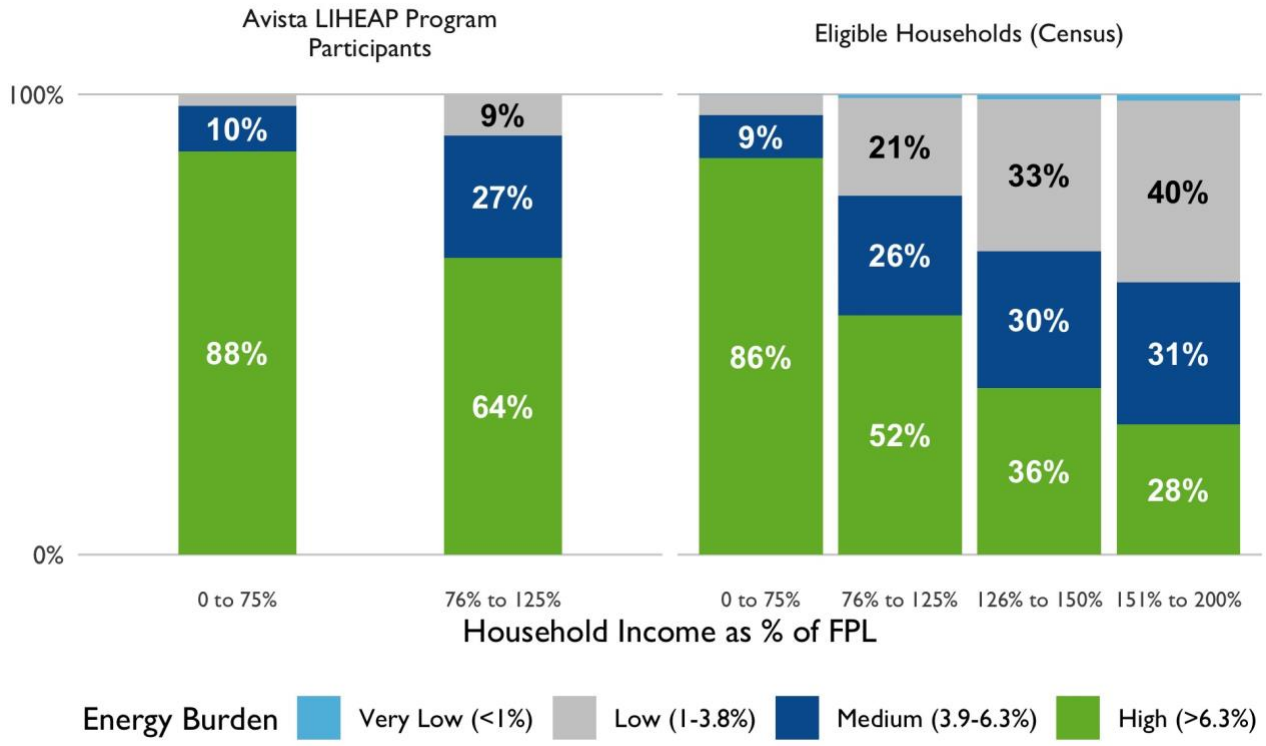
Figure 17: Energy Burden of Eligible Households versus Participants



Source: Energy burden of LIHEAP participants is based on the grant payments, household demographics, and utility billing provided by Avista for program years 2016-2018. Energy burden of the eligible population is based on Evergreen analysis of ACS PUMS for 2013 to 2017.

Figure 18 splits this out further by household income as a percentage of the FPL. In this case, we have expanded the eligible population from LIHEAP to include all of the households eligible for LIRAP Heat. LIHEAP serves households between 0 and 125 percent FPL, LIRAP Heat serves households between 0 to 150 percent FPL, and LIRAP Senior/Disabled Outreach serves those between 151 and 200 percent FPL if the household also contains one or more people who are over 60 years of age or are disabled. The distribution of energy burden for participants between 0 and 75 percent FPL is very similar to the eligible population for the same level of income. The above-average program penetration is limited to those between 75 to 125 percent FPL. As seen on the right-hand side of the figure, energy burden consistently decreases as household income increases within the eligible population. Hence, it is likely that the programs will effectively target higher energy burden households in the region if assistance is targeted towards the lowest income households.

Figure 18: Energy Burden of Eligible Households by FPL



Source: Energy burden of LIHEAP participants is based on the grant payments, household demographics, and utility billing provided by Avista for program years 2016-2018. Energy burden of the eligible population is based on Evergreen analysis of ACS PUMS for 2013 to 2017.

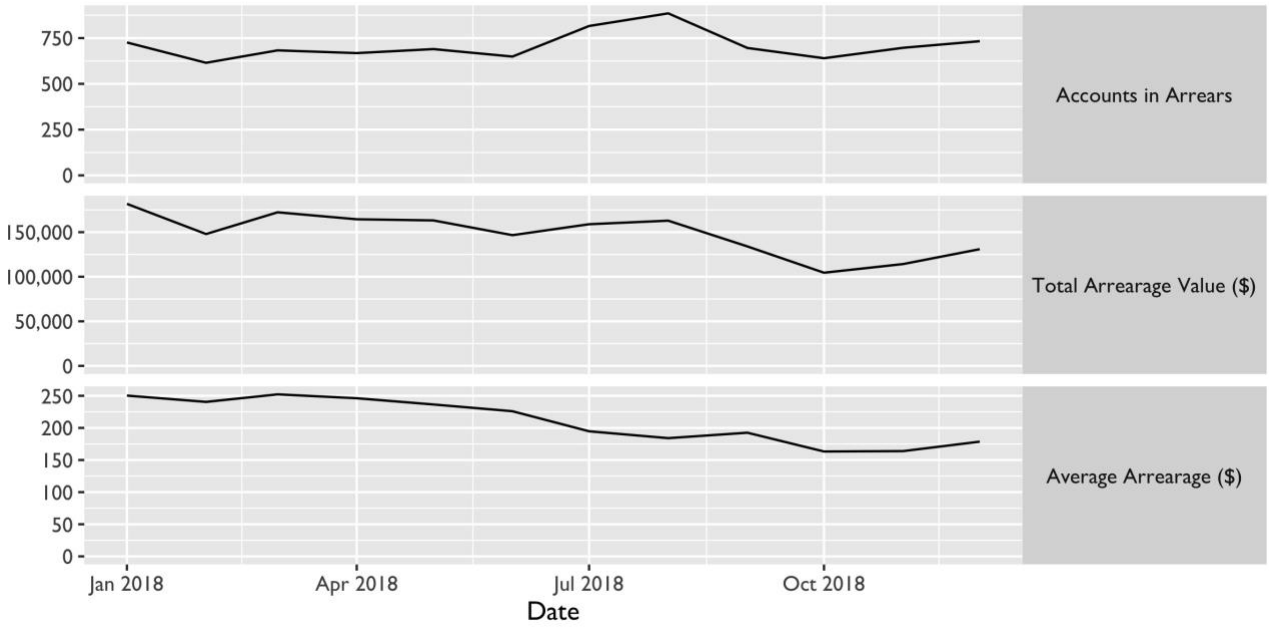
Since the PUMS data also contains some indicators of public assistance (such as food stamps and Medicaid), we also calculated a modified energy burden metric for the eligible population that adjusts household income to include the estimated value of public assistance benefits. The comparison of these two metrics will provide deeper insights into the distribution of need across the population of eligible households. See Appendix B: Modified Energy Burden for more detail on these methods and findings.

3.2 Disconnection Assistance

The four energy assistance programs available to households experiencing financial hardship throughout Avista's Washington service territory are LIRAP Emergency Share, Avista CARES, Project Share, and MISC. There are no explicit income qualifications for these programs. Grants offered through these programs are available to all households experiencing hardship that are at risk of disconnection. This section provides the results of our regression analysis, which aims to identify regional characteristics that can be useful predictors of household risk of arrearages and service disconnection.

Evergreen analyzed Avista data on customer account arrearages from 2015 to 2018, combined with Census ACS data to explore characteristics of small geographic areas with lower or higher rates of arrearages. In 2018, the median proportion of households that experienced a large arrearage (greater than $250) was 0.5 percent for Census tracts in Avista's Washington service territory (the median proportion with any arrearage was 1.1 percent).[8] Figure 19 provides a summary of arrearages in 2018 for Spokane County. For this county as a whole, frequencies of arrearages were higher than the median Census tract, with 2.0 percent of households experiencing at least one arrearage in 2018. On average, these customers were in arrears for slightly more than two months, with an average arrearage value of $199. In January 2018, 0.3 percent of Spokane County accounts experienced an arrearage, resulting in a total arrearage value of $181,740, the highest total for any month that year.

Figure 19: Change in Spokane County Arrearages over Time



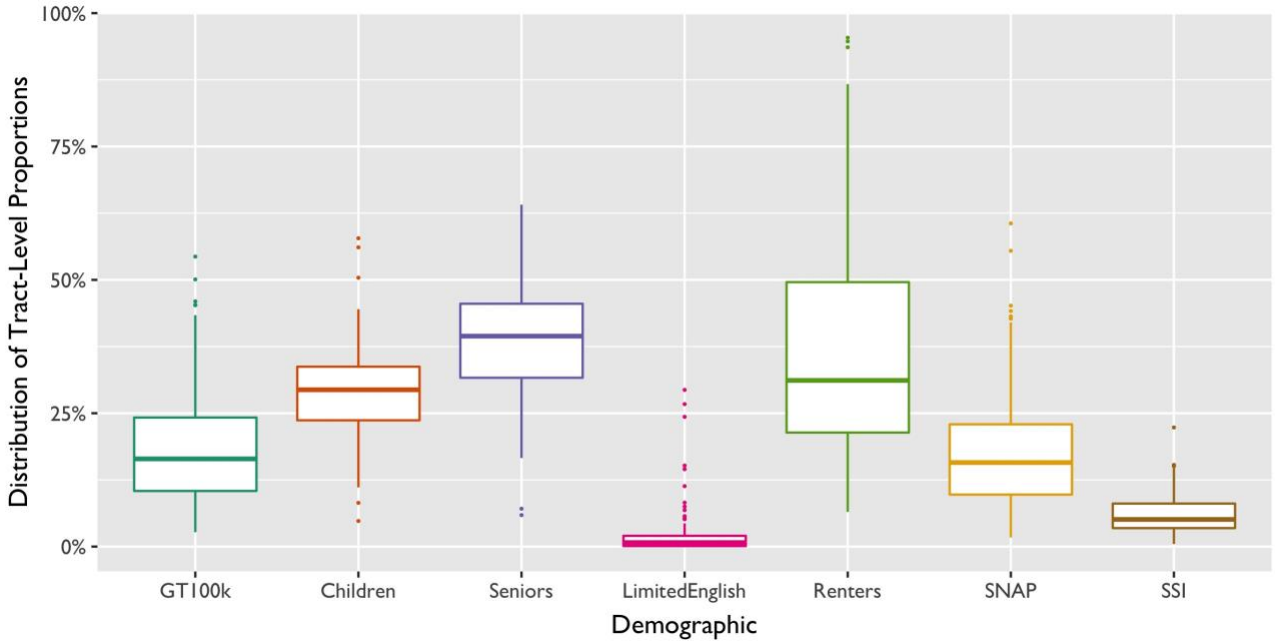
To further investigate arrearages, we estimated regression models for four arrearage characteristics (likelihood of large arrearage, likelihood of any arrearage, average arrearage size, average arrearage amount) using tract-level demographics and aggregations of actual customer arrearages as our inputs.

Figure 20 shows the distribution (i.e., typical ranges) of each of the underlying demographic characteristics used as explanatory variables in these models. For example,

[8] In this case, median Census tract is defined by the tract with the median proportion of accounts with a large arrearage.

the median proportion of households earning more than $100,000 is 16.5 percent, while the 75th percentile is 24.1 percent.

Figure 20: Distribution of Demographic Characteristics



While our models for the likelihood of arrearages produced statistically significant results, our models for number of months spent in arrears (months per year) and average arrearage size ($) did not. This suggests that households experience arrearages (in terms of duration and size) in a similar manner, regardless of demographic characteristics.[9] We have provided the full output from each of the regression models in Appendix A: Detailed Regression Outputs.

[9] The models of arrearage size ($) and number of months spent in arrears (months per year) had a few statistically significant coefficients; overall these two models did not have sufficient explanatory power. Furthermore, the random, normally distributed nature of many of the input variables relative to average arrearage duration and average arrearage size suggested a lack of meaningful relationship. Given the lack of explanatory power of these two models and the lack of correlation between demographic variables and average arrearages, we concluded that the variation in average arrearages (among those who have arrearages) is not related to these demographic characteristics.

For our models of arrearage likelihood, we used the model coefficients to produce estimates of likelihood for a census tract that is typical (i.e. average) and then estimate the impact of variations in each of the independent variables, one at a time.[10]

Table 9 presents the results from the log-odds modeling approach showing the change in the likelihood of arrearages when moving from a typical tract (median for most variables, 'False' for Reservation) to a tract at the 75th percentile ('True' for Reservation) for each demographic characteristic. Table 10 provides the same statistics for the likelihood of a large arrearage (over $250). For example, when moving from a tract that has a median proportion of households with children to a tract that is in the 75th percentile for households with children (29.4% of households to 33.8% of households as shown in Figure 20), the average proportion of households that will experience a large arrearage increases by 0.05 percent, holding all else constant. Given that a household located in a tract with perfectly 'typical' characteristics (i.e., the base case) has a likelihood of having a large arrearage of 0.41 percent, an increase in the presence of children is associated with a 12.9 percentage increase in the likelihood of a large arrearage from the base case. Similarly, households in tracts that are on reservation land have a 0.86 percent higher likelihood of having a large arrearage; this is a 213 percent increase in the likelihood of a large arrearage relative to households that are not located on a reservation.

[10] Due to the functional transformations of the log-odds model, the raw output produced by the model is not easily interpreted. Instead, we applied these coefficients to distributions of characteristics of the population to estimate the likelihood that the dependent variable will change (e.g., proportion of population with arrearages) as the values of the independent variables change individually (i.e., proportional demographic characteristics).

Table 9: Change in Likelihood of Any Arrearage

Demographic – Proportion of Households	Nominal % Change	% Change	% Confidence	Significance Level
GT100k	-0.231%	-20.7%	±5.0%	0.1%
Children	0.168%	15.6%	±4.5%	0.1%
Seniors	0.066%	6.2%	±2.6%	0.1%
Limited English	-0.037%	-3.4%	±1.7%	1%
Renter	-0.071%	-6.6%	±8.4%	25%
Reservation	1.154%	109.1%	±62.5%	1%
SNAP	0.274%	28.1%	±8.2%	0.1%
SSI	-0.046%	-4.2%	±2.9%	5%

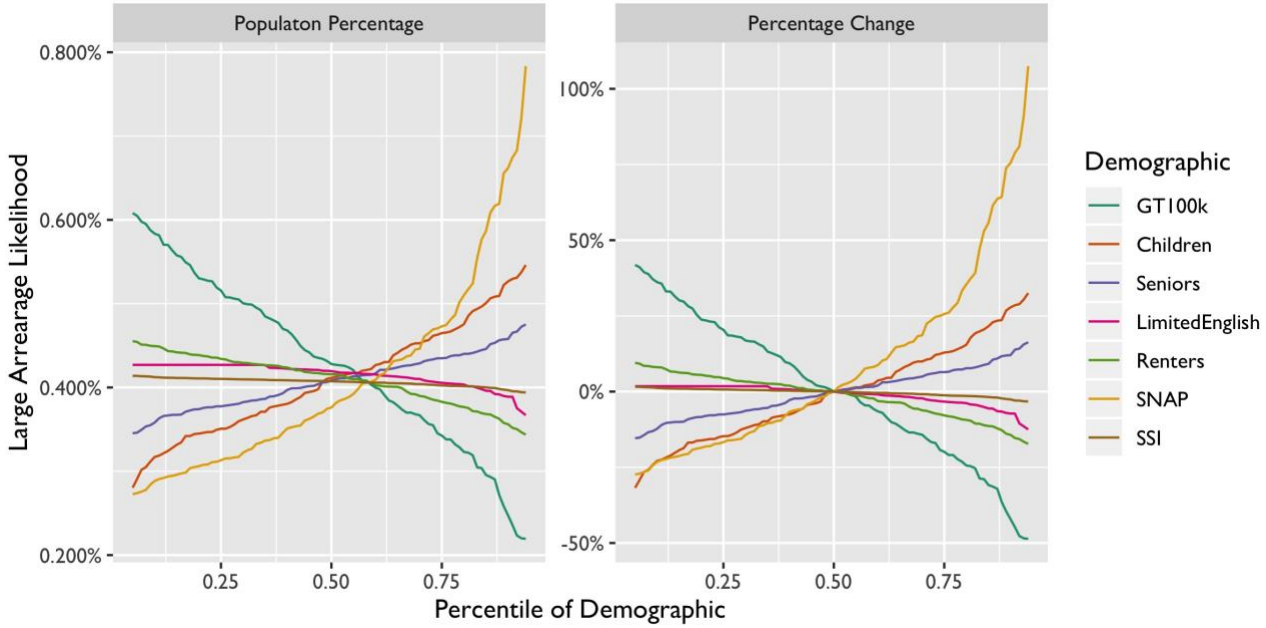
Table 10: Change in Likelihood of a Large Arrearage

Demographic – Proportion of Households	Nominal % Change	% Change	% Confidence	Significance Level
GT100k	-0.085%	-19.9%	±5.0%	0.1%
Children	0.053%	12.9%	±4.5%	0.1%
Seniors	0.026%	6.4%	±3.4%	1%
Limited English	-0.014%	-3.3%	±1.7%	1%
Renter	-0.033%	-7.9%	±8.3%	25%
Reservation	0.861%	213.0%	±78.8%	0.1%
SNAP	0.096%	25.6%	±8.0%	0.1%
SSI	-0.005%	-1.2%	±1.2%	10%

At a higher level, the direction of the change provides some insight into the impact of each characteristic on a household's likelihood of being in arrears. The following are associated with a statistically significant increase in the likelihood of arrearage (i.e., more likely to be in arrears): located on a reservation, number of households that receive food stamps/SNAP benefits, households with children, and households with seniors. The following are associated with a statistically significant reduction in the likelihood of arrearage (i.e., less likely to be in arrears): households with incomes greater than $100,000 per year (GT100k), limited English-speaking households, and those with Supplemental Security Income (SSI).

To further illustrate these results, the same calculations used in Table 10 can be applied to each percentile bucket (not just the 75th percentile) to show how likelihood of arrearages changes with variations in demographics. Figure 21 shows the estimated likelihood of large arrearages associated with increasing percentiles of each demographic trait. The left chart shows these values as nominal, the percentage of the population with a large arrearage, while the right shows how the nominal percentage changes relative to the median value.[11] For example, as the proportion of households receiving SNAP benefits increases in a Census tract, the likelihood that an individual household will experience an arrearage increases as well, from around 0.3 percent to around 0.8 percent, holding all else constant. Relative to the base case of around 0.4 percent likelihood, the tract with an especially low proportion of households receiving SNAP benefits is associated with a 25 percent lower likelihood of a large arrearage, while a tract with an especially high proportion of households receiving SNAP benefits is associated with a 110 percent increase in the likelihood of a large arrearage.

Figure 21: Demographic Impact on Large Arrearage Likelihood



[11] To focus on typical demographic distributions, these charts show only the middle 90 percent of values for each demographic (i.e., excluding the top and bottom 5%). All tracts represented here have at least two characteristics (out of the seven shown) that falls within the middle 90 percent, and 92 percent of tracts have at least five characteristics that are in the middle 90 percent.

4 Conclusions

This section summarizes our conclusions from this research. These are organized by research question and are enumerated below.

What is the current program penetration rate? How many eligible customers have not yet been served?

Between 2015 and 2018, we estimate that 20,255 grants were awarded to Avista service households of the 95,387 households (or 21 percent) that are eligible to receive low-income assistance within its service territory. The estimated program penetration rate ranges from 0 percent (N=0 of 131) in Franklin County to 24 percent (N=15,707 of 65,289) in Spokane County. Note that the majority of households served by Avista are located in Spokane County, which also has the highest proportion of service for income-eligible households. The counties furthest from Spokane, which have a relatively small number of households served by the utility, also have the lowest rates of participation among income-eligible customers. Across all three low-income program offerings and 12 counties served by Avista in Washington state, there are an estimated 75,132 eligible households that have not yet received energy assistance.

Are there any differences in program penetration by customer segment?

The Avista LIHEAP program has a higher rate of program penetration among households containing at least one person with disabilities, low-income households at between 51 and 100 percent of the federal poverty level (FPL), and households with very high energy burden (utility bills over 6.3 percent of household income).

The LIHEAP program has a lower rate of program penetration among renters. Only 34 percent of Avista's LIHEAP participants are renters, but renters make up 62 percent of the eligible population in the Washington service territory, according to our analysis of US Census data for the region. The eligible population of renters includes a large number of households with college students. Renters have much shorter tenures than homeowners, which may make them more difficult to identify and serve with program outreach materials.

Is there any way to predict which customers are likely to experience hardship, or are in need of emergency energy assistance to prevent disconnection?

Our models of customer arrearages identified some regional characteristics (by Census tract) that have a significant impact on an individual household's likelihood of arrearage. Households are more likely to experience an arrearage if they are located on a reservation, in a region with a high proportion of households receiving food stamps/SNAP benefits, or have children or seniors. Households are less likely to experience an arrearage if they are

located in regions with a high proportion of limited English-speaking households or households with Supplemental Security Income (SSI). Avista may opt to conduct concentrated program outreach to Census tracts that have these characteristics in order to reduce the rate of arrearages.

Appendix A: Detailed Regression Outputs

This section provides detailed model output summaries from each of the regression models referenced in the body of the report.

Low-Income program eligibility models:

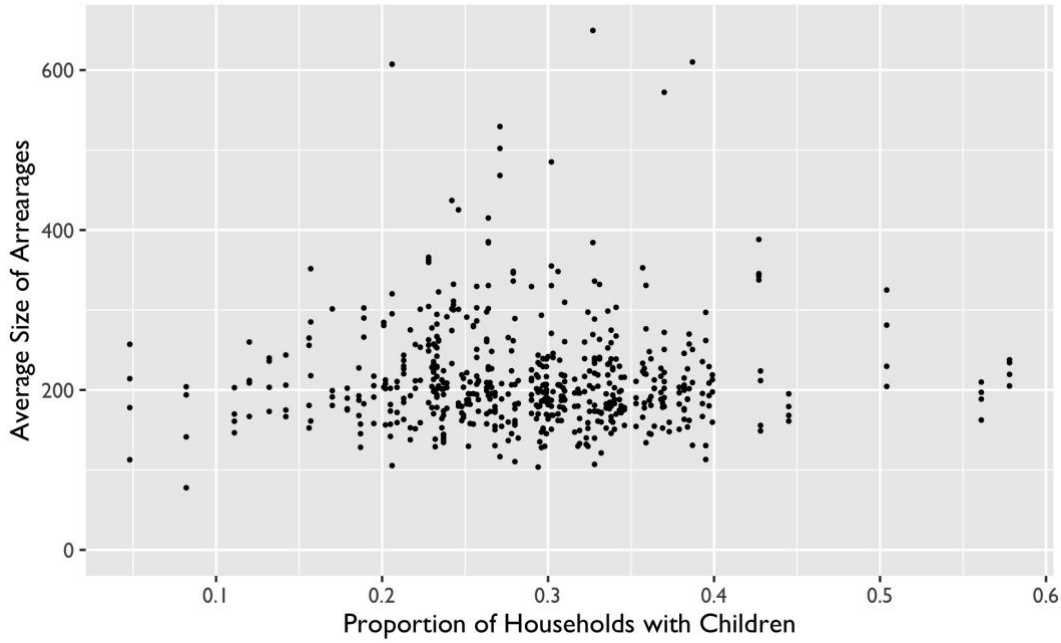
- Table 11: LIHEAP Eligibility Regression Output
- Table 12: LIRAP Heat Eligibility Regression Output
  Table 13: LIRAP Senior/Disabled Outreach Eligibility Regression Output

Arrearage likelihood models:

- Table 14: Likelihood of Any Arrearage Regression Output
- Table 15: Likelihood of Large Arrearage Regression Output
- Table 16: Average Arrearage Amount ($) Regression Output
- Table 17: Average Number of Months in Arrears (months per year) Regression Output

While our models for arrearage likelihood (Table 14 and Table 15) produced significant results, our models for average arrearage duration (Table 16) and average arrearage size (Table 17) did not. While each model had a few statistically significant coefficients, overall the models' fit did not suggest explanatory power. Furthermore, the random, normally distributed nature of many of the input variables relative to average arrearage duration and average arrearage size suggested a lack of meaningful relationships. Figure 22 shows a scatterplot of average arrearage size and the proportion of households that have children. The overall Pierson correlation of these variables is 0.006, suggesting almost no correlation.

Figure 22: Relationship between Average Arrearage Size and Proportion of Households with Children



Given the lack of explanatory power of these two models and the lack of correlation between demographic variables and average arrearages, we conclude that the variation in average arrearages (among those who have arrearages) is not related to these demographic characteristics. That is, in terms of duration and size, households experience arrearages in a similar manner regardless of demographic characteristics.

Table 11: LIHEAP Eligibility Regression Output

Metric	Value
N observations	280
R-square	0.864
Adjusted R-square	0.861
F-statistic	247.5
Degrees of freedom	272
P-value	<0.001

Variable	Coefficient	Standard Error	P-value
(Intercept)	-1.033120	0.588362	0.080
ln(LT35k)	1.221449	0.073832	<0.001
ln(GT100k)	-0.006446	0.03572363	0.857
ln(Seniors)	-0.063338	0.084597	0.455
AvgSize	0.347004	0.063403	<0.001
ln(SNAP)	0.085567	0.043066	0.048
ln(Disabled)	-0.255798	0.085227	0.003
ln(LimitedEnglish)	-0.018953	0.013447	0.160

Table 12: LIRAP Heat Eligibility Regression Output

Metric	Value
N observations	280
R-square	0.887
Adjusted R-square	0.884
F-statistic	305.5
Degrees of freedom	272
P-value	<0.001

Variable	Coefficient	Standard Error	P-value
(Intercept)	-0.49710	0.51120	0.332
ln(LT35k)	1.13740	0.06415	<0.001
ln(GT100k)	-0.03990	0.03104	0.200
ln(Seniors)	-0.02707	0.07350	0.713
AvgSize	0.36229	0.05509	<0.001
ln(SNAP)	0.085567	0.043066	0.048
ln(Disabled)	-0.255798	0.085227	0.003
ln(LimitedEnglish)	-0.018953	0.013447	0.160

Table 13: LIRAP Senior/Disabled Outreach Eligibility Regression Output

Metric	Value
N observations	280
R-square	0.566
Adjusted R-square	0.553
F-statistic	44.2
Degrees of freedom	272
P-value	<0.001

Variable	Coefficient	Standard Error	P-value
(Intercept)	-2.653033	1.172866	0.024
ln(LT20k)	-0.084868	0.103937	0.415
ln(BT20k30k)	0.363589	0.122993	0.003
ln(GT100k)	-0.365907	0.074952	<0.001
ln(Seniors)	0.671062	0.177658	<0.001
AvgSize	0.145794	0.133378	0.275
ln(SNAP)	-0.090320	0.090314	0.318
ln(Disabled)	0.546329	0.177791	0.002
ln(LimitedEnglish)	-0.004782	0.028093	0.865

Table 14: Likelihood of Any Arrearage Regression Output

Metric	Value
N observations	567
R-square	0.448
Adjusted R-square	0.439
F-statistic	50.2
Degrees of freedom	557
P-value	<0.001

Variable	Coefficient	Standard Error	P-value
(Intercept)	-6.3940	0.4009	<0.001
GT100k	-3.0536	0.4451	<0.001
Seniors	2.8570	0.7308	<0.001
SSI	10.6167	4.4353	0.017
SNAP	3.4023	0.6011	<0.001
LimitedEnglish	-2.7424	0.8623	0.002
Reservation	0.7491	0.2609	0.004
Children	3.3742	0.5977	<0.001
Renters	-0.3686	0.2872	0.200
Seniors*SSI	-31.3102	10.7780	0.004

Table 15: Likelihood of Large Arrearage Regression Output

Metric	Value
N observations	567
R-square	0.433
Adjusted R-square	0.423
F-statistic	47.3
Degrees of freedom	557
P-value	<0.001

Variable	Coefficient	Standard Error	P-value
(Intercept)	-6.9649	0.3970	<0.001
GT100k	-2.9063	0.4407	<0.001
Seniors	2.2217	0.7237	0.002
SSI	7.3746	4.3922	0.094
SNAP	3.1110	0.5953	<0.001
LimitedEnglish	-2.6815	0.8539	0.002
Reservation	1.1498	0.2584	<0.001
Children	2.8022	0.5919	<0.001
Renters	-0.4422	0.2844	0.121
Seniors*SSI	-20.1553	10.6732	0.059

Table 16: Average Arrearage Amount ($) Regression Output

Metric	Value
N observations	567
R-square	0.114
Adjusted R-square	0.099
F-statistic	7.923
Degrees of freedom	557
P-value	<0.001

Variable	Coefficient	Standard Error	P-value
(Intercept)	267.32	37.47	<0.001
GT100k	15.54	41.60	0.709
Seniors	-73.88	68.31	0.280
SSI	-666.81	414.57	0.108
SNAP	-19.79	56.18	0.725
LimitedEnglish	122.06	80.60	0.131
Reservation	75.30	24.39	0.002
Children	-63.99	55.86	0.253
Renters	-73.86	26.84	0.006
Seniors*SSI	2556.62	1007.42	0.011

Table 17: Average Number of Months in Arrears (months per year) Regression Output

Metric	Value
N observations	567
R-square	0.135
Adjusted R-square	0.121
F-statistic	9.658
Degrees of freedom	557
P-value	<0.001

Variable	Coefficient	Standard Error	P-value
(Intercept)	0.74281	0.16674	<0.001
GT100k	-0.19242	0.18512	0.299
Seniors	-0.45039	0.30397	0.139
SSI	-3.41169	1.84481	0.065
SNAP	-0.08743	0.25002	0.727
LimitedEnglish	-0.22134	0.35866	0.537
Reservation	0.56608	0.10854	<0.001
Children	0.13681	0.24859	0.582
Renters	-0.28070	0.11945	0.019
Seniors*SSI	12.13233	4.48293	0.007

Appendix B: Modified Energy Burden

The household income and monthly utility costs available in the American Community Survey (ACS) Public Use Microdata Sample (PUMS) data allowed us to calculate the energy burden for each household. The PUMS data also contain indicators of some forms of public assistance (e.g., food stamps); this made it possible to calculate a modified energy burden metric that considers both household income and an estimated value of public assistance benefits. Comparisons of these two metrics can broaden our understanding of hardship and burden among low-income households being targeted by Avista's low-income energy assistance programs.

We assumed that benefits from social security, disability, supplemental security income (SSI), and unemployment are already included in self-reported income because these are cash benefits issued in regular time intervals with predictable values. Other benefits, such as Medicaid, food stamps, and housing, can have a substantial impact on a household's expenses, but the value of these benefits is likely not accounted for in self-reported income.

The goal of this analysis is to calculate a modified energy burden by adding the value of government assistance benefits to the household income. This modified income should be interpreted as an upper bound, with the true income (and thus energy burden) falling somewhere between this modified income and the original.

When adjusting for the value of such non-cash benefits, our prior research has shown that the burden for households at the lowest levels is significantly reduced.[12] The combination of these two metrics will provide deeper insights into the distribution of need across the population of eligible households.

Equation 6: Traditional and Modified Energy Burden Metrics

$$Energy\ Burden\ = \frac{Household\ Energy\ Costs}{Gross\ Household\ Income}$$

$$Modified\ Energy\ Burden\ = \frac{Household\ Energy\ Costs}{Gross\ Household\ Income\ +\ Value\ of\ Assistance}$$

The following assistance benefits are included in our modified energy burden calculation:

[12] Fraser, Jenny, Tami Rasmussen, Ingo Bensch, and Carol Edwards. 2017. "More Tools in the Toolbox – An Examination of Metrics for Low-Income Customer Energy Burden." Paper presented at the International Energy Program Evaluation Conference in Baltimore, MD. https://www.iepec.org/wp-content/uploads/2018/02/2017paper_fraser_rasmussen_bensch_edwards-1.pdf

- **Food benefits.** Food benefits consist primarily of food stamps, also known as the Supplemental Nutrition Assistance Program (SNAP). These benefits have cash value but can only be used to purchase food. According to the ACS PUMS, around 37 percent of households that are eligible for low-income energy assistance in the region also receive food stamps. We estimate the average value of benefits to be $208 per year.[13] Many families with children who are eligible for food stamps also receive food benefits in the form of free lunches through the School Lunch program and vouchers for specific food items through the Women, Infants, and Children (WIC) program.
- **Medical benefits.** Our estimated value of medical benefits includes Medicaid but not Medicare. We estimated the value of Medicaid in terms of its impact on out-of-pocket spending (i.e., amount paid by self), rather than its impact on total medical expenditures (i.e., amount paid by insurer). According to the ACS PUMS, 52 percent of households that are eligible for energy assistance in the region also have at least one person in the household receiving Medicaid benefits. We estimate the average value of these benefits to be $636 per person per year.[14]

Due to limitations in the ACS PUMS, we were not able to consider housing or other cash benefits. Housing benefits include public housing, subsidized housing, and Section 8 vouchers which all reduce household expenditures on housing. Housing benefits are worth an average of $214 per month or $2,572 per year across the Washington counties served by Avista.[15] Other cash benefits include Temporary Assistance for Needy Families (TANF), which is available to low-income households with children, providing a further reduction in their modified energy burden.

We used the self-reported household income, public assistance benefits, and typical monthly utility bills to estimate the energy burden and modified energy burden for each

[13] The value of SNAP benefits is based on the average annual household benefit received by households in Washington state, filing dated 06/05/19.
https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap
[14] The value of Medicaid benefits is based on the difference in out-of-pocket spending on medical bills by low-income households (<200% FPL) in the western United States. According to this 2015 study, households with Medicaid spent an average of $126.20 per year, while those without Medicaid spent an average of $762.28. Those without Medicaid are uninsured or covered by another form of health insurance, such as an employer sponsored health plan.
https://meps.ahrq.gov/mepsweb/data_stats/MEPSnetHC/results.action
[15] Value housing subsidy estimated as (Fair Market Rent-0.3* Household Income)*(.44*Area Housing Costs/National Average+0.56). The subsidy is capped at the cost of 2-bedroom housing in the county (where the household is located) after the household has contributed 30 percent of their income.
https://www.huduser.gov/portal/datasets/fmr/fmrs/FY2018_code/2018state_summary.odn

household that met the income qualifications for one or more of Avista's low-income energy assistance programs.

Figure 23 shows the distribution of energy burden of each eligible household, grouped by income as a percentage of the federal poverty level (FPL). Figure 24 provides the same visualization of modified energy burden, accounting for the dollar value of food stamps/SNAP and Medicaid as part of household income.

This side-by-side comparison of the traditional and modified energy burden confirms that these forms of public assistance reduce burden for the eligible population. In the lowest income group with income between 0 and 75 percent FPL, 86 percent have a high energy burden compared to 82 percent that have a high modified energy burden. Public assistance appears to reduce energy burden for all four income groups, with larger impacts for households below 125 percent FPL. Keep in mind that we were only able to consider the value of food stamps/SNAP and Medicaid benefits; many of these households will also qualify for housing subsidies and other forms of cash assistance that will further reduce their energy burden.

Figure 23: Energy Burden of Eligible Households by FPL

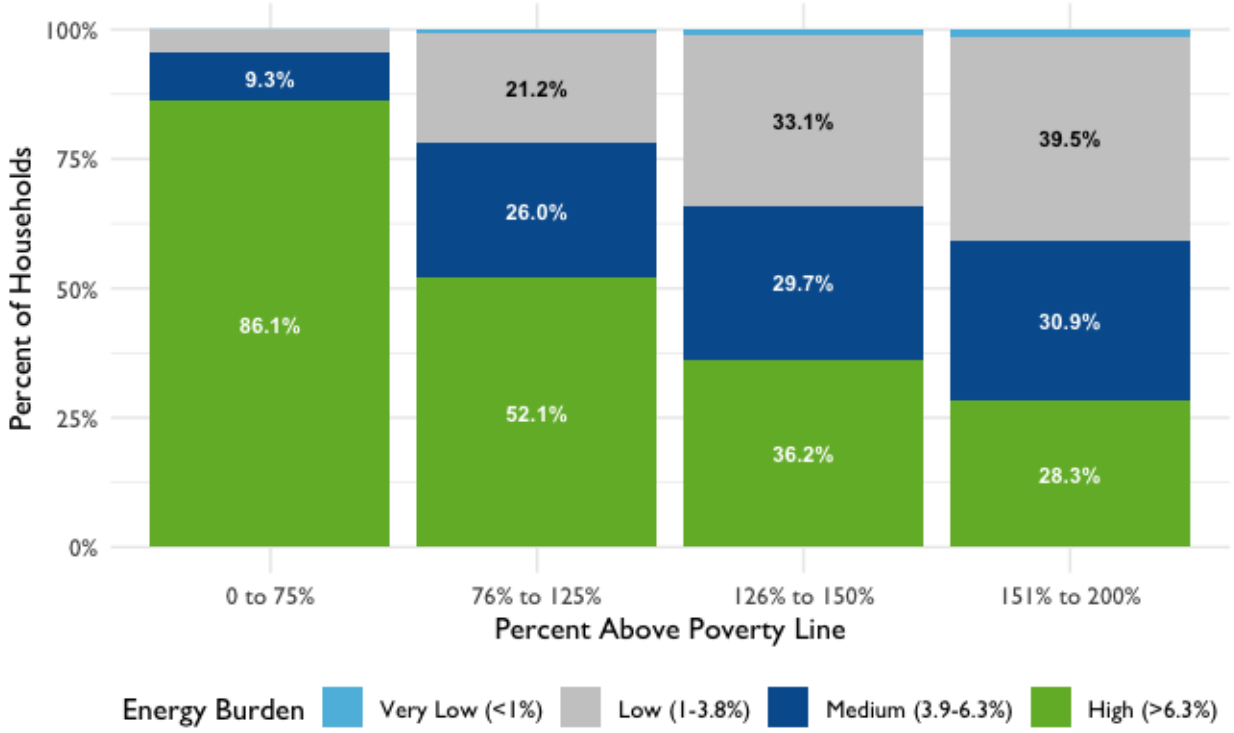
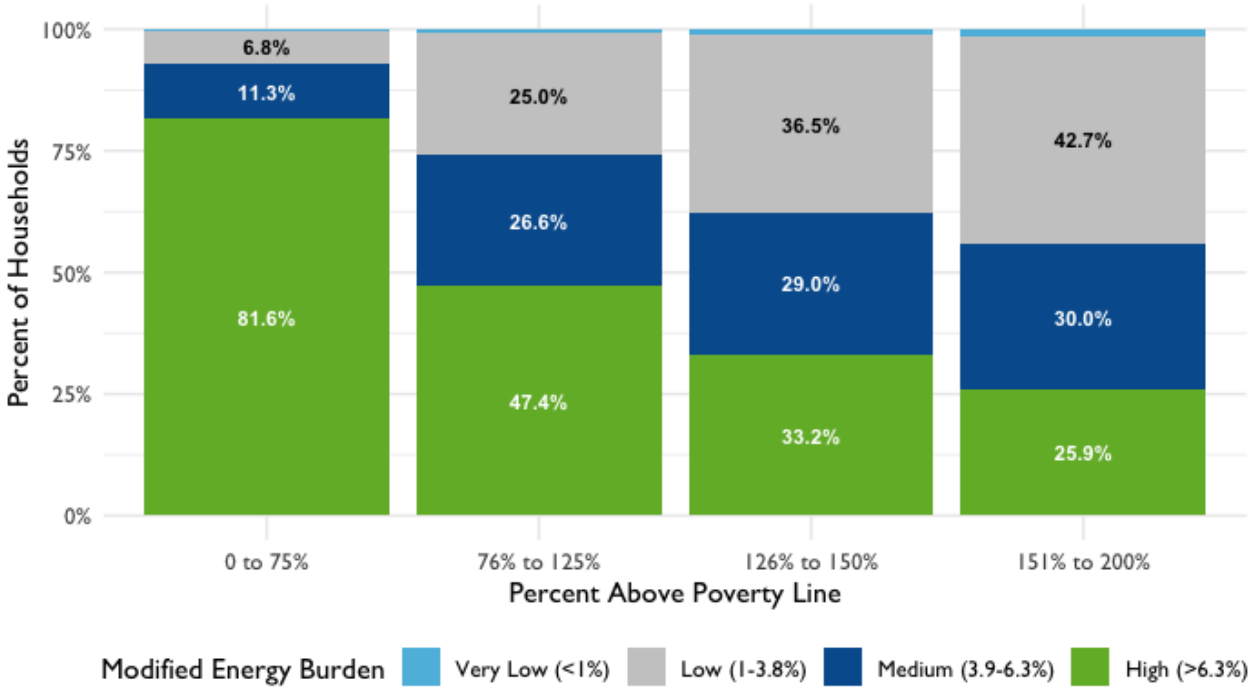


Figure 24: Modified Energy Burden of Eligible Households by FPL



Appendix C: PUMA Characteristics

This section provides additional statistics to characterize the US Census Public Use Microdata Area (PUMA) regions in the state of Washington that contain households served by Avista.

Table 18 shows the average number of households within each PUMA between 2013 and 2017 with the labeled characteristics (e.g., LT20k: household income less than $20,000) corresponding to explanatory variables used in the eligibility models for LIHEAP and LIRAP. The last column on the right provides the average household size. We have ordered the PUMA regions (rows) by the number of households served by Avista (electric and/or gas).

Table 18: Characteristics of PUMAs that Overlap with Avista Territory

PUMA	All Households	LT20k	BT 20k30k	LT35k	GT100k	Seniors	Disabled	SNAP	Limited English	Avg Size
Spokane (South)	10,296	2,186	1,730	3,916	2,065	3,620	2,861	2,135	221	2.232
Spokane (North)	10,295	1,908	1,825	3,733	1,481	3,678	3,229	2,273	188	2.446
Spokane, Valley City	10,555	1,545	1,753	3,297	2,287	3,904	3,147	1,669	103	2.488
Pullman	7,980	1,835	1,381	3,216	1,337	2,858	2,331	1,152	433	2.350
Cheney City	7,853	967	988	1,955	2,165	3,109	2,092	865	40	2.631
Stevens County	8,660	1,892	1,564	3,456	1,298	4,241	3,135	1,635	126	2.424
Toledo	8,599	1,620	1,463	3,083	1,391	4,014	3,204	1,590	116	2.402
Walla Walla	7,650	1,166	1,032	2,198	1,745	2,887	2,322	1,191	407	2.592
Grant County	9,632	1,586	1,628	3,214	1,761	3,612	2,609	1,730	541	2.628