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Assessing Heating Assistance Programs in Spokane County

By:
Grant Forsyth, Ph.D.
D. Patrick Jones, Ph.D.
Mark Wagner, MA

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Grant Forsyth, Ph.D.
Department of Economics
Institute for Public Policy and Economic Analysis, EWU

D. Patrick Jones, Ph.D.
Institute for Public Policy and Economic Analysis, EWU

Mark Wagner, MA
Institute for Public Policy & Economic Analysis, EWU

A Report to
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Executive Summary

This study examines the recent experience of the two largest heating assistance programs in Spokane County: the federal Low Income Home Energy Assistance Program (LIHEAP) and the Avista Utilities-funded Low Income Rate Assistance Program (LIRAP). The study's central goal is to assess the reach of these programs among the eligible population. While both programs target low income households, the LIHEAP statute demands that attention be given to three sub-groups: households with at least one senior, households with at least one child less than five years of age and households with at least one member with a disability. The study was able to estimate total number of low income households and of one of the sub-groups, those with seniors.

The study team reviewed the relatively scant literature on heating assistance programs to frame the results found for the County. There are several approaches of calculating the income share of household expenditures on heat or energy. One must first keep a clear distinction between residential energy and heating in any reading of the data and analysis. Much of the literature takes up residential *energy* shares or burden. *Heating* shares or burdens, the focus of this study, are a subset of energy shares, usually at around the 40% range.

Analysis conducted for the federal administrator of the LIHEAP program, the Department of Health & Human Services, points out that both measures of a "typical" household, mean and median, are appropriate. The mean is the average of any distribution of numbers, while the median is the central value at which 50% of the numbers lie above and 50% lie below. The same analysis uses two different ways of calculating the mean and median ratios. The first uses actual individual household ratios, while the second uses heating costs summed across groups of certain sizes, divided by the sum of household income for those groups.

Both approaches are valid, but yield considerably different results. For example, from the sample of all households in the most recent national survey (2006 updated data), the mean for "individual" shares of heating expenditures was 2.9%. However, the mean of "group" shares was 1.1%. In this study, data availability led to an adoption of nearly all approaches.

A final methodological consideration taken up by this report is a review of the threshold above which a heating expenditure share becomes a "burden". There are a variety of ways that one might set this threshold and they are briefly considered in the narrative. The two research groups that have published in the field have determined a threshold based on total housing, or shelter, costs. They first examine the energy component for those households spending 50% or more (high burden) and those households spending between 30% and 49% (moderate burden) of their income on shelter. They then apply a percentage of heating costs to the energy cost component. The result: a *high* burden is 4.3% or more while a *moderate* burden is one between 2.6% and 4.2% of household income. Note that these calculations are based on "individual" ratios.

Since paired household heating expenditure and income data sets were unavailable to the research team, the estimation of the number of Spokane households eligible for heating assistance proceeded on the basis of income alone. The LIHEAP statute allows two low-income standards: at some multiple of the Federal Poverty Level (FPL) and at 60% of a state's median household income. The analysis took up both approaches; however, only the results from the FPL approach, at 125% and 150%, are given below, since Washington State has adopted the 125% threshold. As no current, detailed estimates of household income were available, a distribution was developed from the 2000 census for each census tract in the County. This allowed the estimation of the number of

households that would fall at or under the 125% and 150% of the FPL for each tract.

The result for 2008: about 43,000 eligible or "at-risk" households in the County had income low enough to qualify for LIHEAP or LIRAP. This represented about 24% of all County households. According to the most recent national estimate, the number of income eligible households is about 21%; the share at the state level is about 18%. While the share of Spokane County is higher than both benchmarks, poverty in the County, as measured the share of the population at the FPL, is also considerably higher.

Using a similar approach to examine low-income households with at least one member age 65 or over who are at-risk, the research team arrived at a 2008 estimate of 9,400. This represents about 26% of all Spokane County senior households.

A spatial distribution of at-risk households shows that they are concentrated in Spokane City, with the heaviest clusters in the central and eastern sections. This study also forecasted the growth of the at-risk number of households over the 2010-2012 periods. It used two different techniques to arrive at an estimate of these households growing by slightly more than 500 per year over 2008 numbers.

The second strand of the data analysis dealt with the production of current heating costs for all of Spokane County households. Coupled with the census tract estimates of median household income, heating costs estimates allowed the calculation of heating shares for all tracts in the County. This is an example of the group approach to examining heating shares or burdens.

Developing the heating costs estimates by census tracts posed considerable challenges. The research team gathered monthly, anonymized billing information from most of the electric utilities in the County. Sorting the information into mutually exclusive classes of customers, by fuel use, was daunting, however. The four major heating sources are natural gas, electricity, fuel oil and liquid propane gas (LPG). With the exception of the natural gas data supplied by Avista Utilities, heating cost data from the other the sources was either not current or was "mixed" with general electricity consumption.

In the end, some simplifying assumptions were necessarily made about the natural gas use by residences whose electricity comes from utilities other than Avista. The number of households currently using fuel oil and LPG was assumed to be the same as in 2000. Heating costs for the utilities from which no data were retrieved were approximated by heating costs from their non-profit peers.

The result was a ratio of average heating expenditures to median household income for every County census tract in heating season 2008. (In the study, heating seasons are labeled by the year in which they end.) As Appendix B shows, the ratios range from 0.49% to 4.13%. The average of all census tracts was 1.4%. The distribution was hardly uniform, as the maps in section 7 reveal. Consistent with the spatial distribution of household income shown in section 5, the census tracts with the highest energy shares were predominantly in the central part of the City of Spokane, followed by concentrations in the northeast of the City, Cheney, the western part of Spokane Valley, Millwood and the eastern part of the West Plains area.

With its 2008 average, the County is not very different from the national, all-household group mean of 1.1% for 2006. If the research team had access to census tract household income means instead of median values, the Spokane County average would likely be smaller, and consequently even closer to the national group mean.

The final strand of analysis in this report is a detailed look at the administrative data from the administrator of the County's LIHEAP and LIRAP programs, SNAP. This was done for the period 2004 through 2009. Highlights of the results, described in section 6, are:

- The total number of households served has fluctuated between approximately 8,800 and 11,000, until the most recent heating year when 13,140 were assisted.
- Use of LIRAP has declined in the past two heating seasons.
- The mean benefit, from both LIHEAP and LIRAP, has gone up 19% between heating seasons 2004 and 2009, from $467 to $557.
- The gross (pre-assistance) median heating burden of all SNAP-assisted households has gone up by 13% over the same period, from 5.4 to 6.1% of household income.
- The net (post-assisstance) median heating burden for all SNAP-assisted households has gone up by 75%, from 0.8% to 1.4% of household income.
- Between heating seasons 2004 and 2008, SNAP served between 22% and 26% of the eligible, or at-risk households.
- With the large spike in service delivery in 2009, SNAP served nearly 30% of eligible households. (This includes LIHEAP & LIRAP.)
- Geographic analysis of SNAP activities reveal for the most recent years that five Spokane City zipcodes 99207, 99205, 99202, 99201, 99208 account for over 50% of all assisted households.
- Spatial analysis shows that the median gross heating burdens for these zipcodes ranged from 5.1 to 6.5%, with one exception: zipcode 99201 was at 7.4% in 2009.
- Spatial analysis also shows that median gross heating burdens increase from urban to rural locations.

A comparison of the drop in the median Spokane heating burden from gross to net to the latest national averages of gross and net shows SNAP awards lowering the burden by a far greater percentage. Finally, the 2009 estimate of 30% coverage of eligible households by SNAP assistance is considerably higher than the most recent national average of 16%.

2. Study Origins

Low-income residents in Spokane County are eligible for two kinds of financial support for their heating needs. The first comes from a federal program, the Low Income Home Energy Assistance Program, or LIHEAP. Originally enacted in 1981, its current purpose is "to assist low income households, particularly those with the lowest income, that pay a high proportion of household income for home energy, primarily in meeting their immediate energy needs." [1] A second source of relief comes from the large investor-owned utility in the eastern Washington, Avista. Since 2001, it has funded a similar program to LIHEAP, the Low Income Rate Assistance Program, or LIRAP.

In heating year 2008-2009, 10,459 households in the County received LIHEAP assistance. In the same heating year, 2,681 County households were able to take advantage of LIRAP, for a combined total of 13,140 households assisted. This represented an increase of nearly 4,000 households aided by the two programs from the prior year, largely due to monies put into the LIHEAP program by the federal American Recovery and Reinvestment Act.

Despite this impressive jump in coverage, administrators, users and funders of the two programs are concerned about the programs' adequacy in covering all Spokane households eligible for heating assistance. As a consequence, the Institute for Public Policy & Economic Analysis at Eastern Washington University was commissioned to study the issue. Specifically, the Institute was charged with investigating:

- The definition of energy burden for low-income households;
- An estimate of the total number of low-income households in the County who currently qualify for one of the two programs under some definition of energy burden;
- An estimate of the number of low-income households in the County who will likely qualify over a subsequent three year period;
- An estimate of the number of low-income households headed by seniors who currently qualify for the two programs
- An analysis of the households recently served by the two programs; and
- A depiction of the geographical distribution of households served by the two programs and households who generally might qualify.

3. Program Review & Definitions

3.1 LIHEAP

LIHEAP currently targets two types of low income households: those with high "burden" and those who are "vulnerable". High burden is generally defined as very low incomes and high home energy costs, while vulnerable households consists of those with at least one young child (< 5 years), or a member over 60 years of age, or a member with disabilities. The federal LIHEAP statute defines a low income household as one at or below the 150% federal poverty level (FPL) or the 60% threshold of a state's median household income, whichever is greater.

As a block grant program, LIHEAP's eligibility standards vary by state. Since the federal dollars allocated to each state are inadequate to cover all households who qualify, most states use the FPL threshold, a lower amount than the median income measure. Federal statute allows states to set a threshold below the 150% of the FPL, but it must lie above 110% of the FPL. In Washington State, the administrator of the program, the Department of Commerce, uses the threshold of 125% of the FPL.[2] In Spokane County, LIHEAP is administered by the Spokane Neighborhood Action Program, or SNAP, a community action agency in operation since 1966. The relative sizes of the two most recent LIHEAP allocations are shown in Table 3.1.

In heating season 2007-08, Washington State received 2% of all federal LIHEAP dollars; in heating season 2008-09, the share slipped to 1.7%. While the state's population in 2008 made up 2.2% of the U.S. total, its estimated poverty rate (at the FPL), at 11.3%, was considerably lower than for the U.S., estimated at 13.2%. In heating season 2007-08, Spokane County received 8.2% of the state total; in heating season 2008-09, the County share was 8.0%. While Spokane County made up 7% of the state's population in 2008, its estimated poverty rate was considerably higher than the state's: 13.7% vs. 11.3%.[3]

Table 3.1: Recent National, Washington State & Spokane County LIHEAP Allocations

Jurisdiction	Season 2007-08 $	Season 2008-09 $
U.S	1,977,027,460	4,476,301,613
WA [a]	40,449,571	74,602,937
Spokane County [b]	3,323,914	5,993,070

a. The Washington state allocation included $1.631M and $3.035M for tribal governments in the two years.
b. Spokane County values are actual expenditures

Sources: for the U.S. & Washington: U.S. Department of Health & Human Services, Administration for Children & Families, http://www.acf.hhs.gov/programs/ocs/liheap/funding/fund.html,; for Spokane County, administrative data from SNAP.

Although the LIHEAP statute defines assistance for energy, SNAP administers its program for the heating season only. This conforms to the Washington State Department of Commerce guidelines. As a consequence, this study examines *heating* assistance and burden.

3.2 LIRAP

The Low Income Rate Assistance Program, or LIRAP, is funded entirely by Avista Utilities and supplements the assistance offered by LIHEAP. It is meant to extend the reach of LIHEAP; consequently, if a household receive LIHEAP dollars, it is ineligible for LIRAP help. The general eligibility requirements are the same as LIHEAP, with apparent preference given to those with the highest heating burden. The program is restricted to Avista's customers, those who are "least able to pay their bills."[4]

It is offered in two of the three states that comprise Avista's service territory. Its funding comes largely from a surcharge on its

customers bills, amounting to approximately 0.8% of the base rates for both electricity and natural gas. Some funding also comes from the utility's philanthropic campaign, *Project Share*, as well as from a separate set of donations from Avista employees and shareholders. In Spokane County, LIRAP expenditures for the 2007-08 heating season amounted to $1,322,496; in the 2008-09 seasons, they increased to $1,616,643.

Avista Utilities engages the same community action agencies who manage the LIHEAP to administer LIRAP. In Spokane County, this is SNAP.

3.3 Determination of Heating Burden

As conventionally defined, heating burden is generally the ratio of household heating costs to household income. As such, for an individual household, the ratio defines the share of total income taken up by heating expenditures. In the economics of consumption, analysts examine this ratio simply as a share, not a "burden". The latter term implies a position in a household's budget that creates problems of matching income with expenditure. Problems of "meeting budget" might arise for households, but likely not low levels of this share. What then, constitutes a high level, or one that might be construed as a burden?

One might look at national or regional summary data to gain some insights. The most recent detailed, household-level information set at the national level comes from the Department of Energy's quadrennial Residential Energy Consumption Survey, or RECS. A summary of the findings, as reported in the *2006 LIHEAP Home Energy Notebook* (2008) are presented below. The data stem from the year of the most recent survey, 2001, and have been updated by the report to 2006 values.

Table 3.2: Home Heating Shares, U.S. and Western U.S. for Federal Fiscal Year 2006

Household type & Measurement	All U.S. %	Western Region %
Mean group shares		
All households	1.1	0.6
Low income [a]	3.8	2.0
LIHEAP recipients	6.8	3.6
Mean individual		
All households	2.9	1.6
Low income	6.3	3.3
LIHEAP recipients	11.2	6.5
Median individual		
All households	1.3	0.8
Low income	3.0	1.6
LIHEAP recipients	7.1	5.5

a. Low income households are those that fall into the LIHEAP definition of at or below the 150% threshold of the FPL or at or below 60% of the state's median household income.

Source: U.S. Department of Health & Human Services, Administration for Children & Families (August, 2008), Tables A-5a-c.

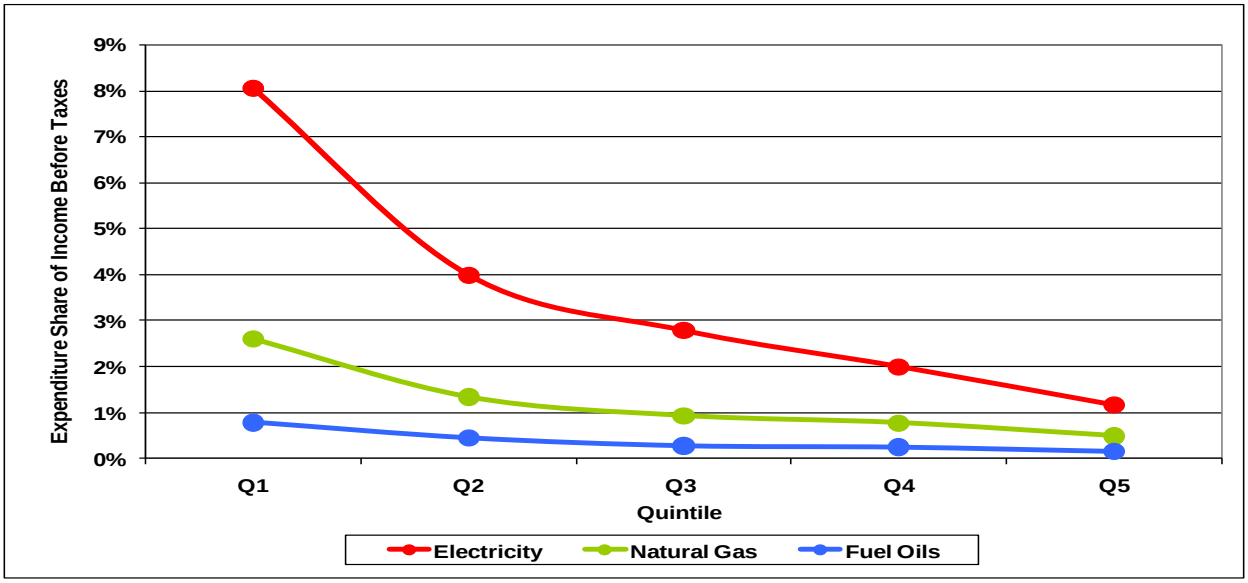
Table 3.2 presents heating shares in several ways, and these merit a brief discussion. The first is a distinction between "individual" and "group" shares. The former category represents first the calculation of individual household ratios or shares, then of the average of these shares. Group shares are the result of first summing all individual household heating costs, then summing all individual household incomes, and dividing total heating costs by total household income.

The two methods will typically yield different results, because typically heating costs do not increase at the same rate (linearly) as incomes increase. For example, an examination of the 2007 Bureau of Labor Statistics (BLS) Consumer Expenditure Survey reveals that the relationship between income and energy (and presumably heating) expenditures is non-linear, moving

from low- to high-income households, and highlights the difficulties low income households face with rising prices or falling incomes.

To illustrate, Figure 3.1 shows the ratio of average household energy expenditures to average gross household income for each quintile in the U.S. in 2007 (Q1 = the poorest 20% of households and Q5 = the wealthiest 20%). Notice that for each energy source (electricity, natural gas, and fuel oils), the poorest quintile, Q1, always has the highest relative expenditure share. With respect to electricity, Q1's average share is around 8%, which is twice as high as Q2 and eight times higher than Q5. This means sharp increases in energy prices will be felt more acutely by low-income households since they will face more painful reductions (or eliminations) in the consumption of both energy and other goods/services to offset the increased share of energy costs in the household budget. If households are already operating at the minimum level of energy use for a livable environment, then expenditures reductions will come entirely from all non-energy related goods and services.

Figure 3.1: Average U.S. Household Expenditures on Energy by Income Quintile, as a Share of Household Income before Taxes



Source: 2007 BLS Consumer Expenditure Survey

The pattern in Figure 3.1 is also consistent with survey data in the *2006 LIHEAP Home Energy Notebook*. The study finds a 2006 median residential energy (all uses, not just space heating) share of 3.1% higher-income households, 9.5% for low-income households, and 15.3% for households that received LIHEAP support (p. 4, Table 2-1).

Consequently, when one discusses levels of energy shares, or burden, it is important to note how the calculation was made – on the basis of individual household ratios or summing heating bills and household income for a population over a known geography, then calculating a ratio. In this study, both approaches are taken.

Note that Table 3.2 shows both mean, or average, and median values. (The median is the value in a distribution of numbers at which 50% of the values lie above it and 50% of the value lie below it.) Both are measures of "central tendency," of the middle of a distribution of measurements. Both are measures of what might be consider "typical". In a symmetrical

distribution, the mean and the median are the same. In a skewed distribution, they are not. As Figure 3.1 shows, the distribution of energy shares is highly skewed. When a distribution is not symmetrical, very often the median is a preferred measure of the middle. Finally, Table 3.2 presents the results for both the U.S. and the Western U.S. Census region.[5] As one can observe, considerable differences exist between the two columns. The Western U.S. shows lower values than the all-state average.

Several observations follow from Table 3.2. As stated generally above, the values of mean heating shares calculated for *individual* households are larger than the mean heating shares calculated on a *group* basis. Second, heating shares in the Western U.S. are considerably lower than the U.S. average, nearly 50% in most categories. Third, as seen in the energy shares of Figure 3.1, heating shares faced by low income households are larger than for the entire population of households, typically by more than 100%. Fourth, from a program evaluation perspective, the much higher heating shares shown by LIHEAP recipients reflects the preference given to the "lowest of the low" by most local program administrators. Fifth, as mentioned above, median heating shares, calculated on an individual household basis, are considerably lower than mean heating shares calculated on an individual household basis. This stems from the asymmetrical distribution of heating shares.

Table 3.2 serves as a reminder of the complexity of measuring heating shares and of the care one must exercise in setting up benchmarks. Its values represent the current best measurement of the size of household budgets taken up by heating costs. The unanswered question from these share calculations is at what threshold do they represent a "burden"?

There are no hard and fast rules to determine this and one necessarily enters into the realm of value judgments. In an earlier study (APPRISE, 2005), the authors of the *LIHEAP Home Energy Notebook for 2006* discussed three general approaches to determining a burden threshold. One involves ordering all households by energy (or heating) shares and setting a cut-off at a certain percentage of all households, one that ostensibly captures the highest burdened households. This raises the question of where cut-off should be drawn. Another approach is to use the statistical tool of standard deviation and set the cut-off at one standard deviation above the mean share value.[6] This rule certainly does not have any rationale beyond the presumption that households with energy (heating) shares that are a certain distance away from the mean, or typical, household, deserve some kind of assistance.

The approach the authors recommend and use is a variant of the income share approach depicted in Table 3.2. In a third study by APPRISE (2007), one for Washington State, they note the approach taken by the consulting group Fisher, Sheehan & Colton for *energy* burden. This group draws on the literature of shelter (housing and energy) affordability, which often uses 30% of household income to set the threshold. Fisher et al then invoke their own research on energy costs as a share of total shelter costs to suggest that about 20% is average. Consequently, the level of energy share of income at which a burden will arise is 6% (20% of 30%).

To translate the energy calculations into a *heating* threshold, one would need to apply the percentage of total energy costs taken by space heating. This varies across the country. According to the *2006 LIHEAP Energy Notebook* (2008), space heating takes up about 37% of total energy costs nationally. Applying this percentage implies a "burden" threshold of 2.2% for all households.

The Apprise authors use a similar approach. They note that a "severe" shelter burden is one in which 50% or more of household income goes to shelter expenditures. They cite their own research that 22% of shelter costs are

attributable to energy expenditures in low income households. Consequently, a "severe" energy burden threshold for these households is about 11%. They provide similar calculations for the 30% of household income rule, and arrive at a value similar to Fisher et al of 6.5%. They label this a "moderate" residential energy burden.

To translate these two cut-off points in household income into a heating burden threshold, they apply a 39.3% share taken by heating *and cooling* nationally of energy expenditures. The results: "high" heating & cooling burden is 4.3%, while a "moderate" heating & cooling burden is one greater than 2.6% but less than 4.3% of household income. Compare these thresholds to the average values reported in Table 3.2 for Western U.S. low income households: 2.0% for the group calculation and 3.3% for the individual household calculation.

As noted in the introduction, this study examines heat burden. The focus on heat burden reflects the distribution of LIHEAP and LIRAP monies over the winter months in Spokane County. The distribution of monies for winter heating bills is a response to regional energy bills spiking during the coldest (rather than the hottest) months of the year. Therefore, if the heat burden of Spokane County households exceeds the LIHEAP thresholds for both heating and cooling costs, then it is likely that their energy burden for heating *and* cooling is higher.

While threshold calculations are necessary to arrive at some operational rules for evaluating low income heating programs, it is obvious that they rest on certain assumptions. Whether these are correct is the subject of ongoing research. It bears repeating that these calculations are based on *national* averages. As table 3.2 makes clear, there are distinct regional variations. Indeed, as the Apprise study for Washington state (2007) notes, there are substantial differences in energy costs, and presumably energy (as well as heating) thresholds within the state.

Finally, these national averages obscure variations among groups targeted by low-income heating assistance programs. For example, it is likely that the senior population has an expenditure mix different than the population at large. If they are home owners and have been living in the same dwelling for years, they, as a group, may face lower shelter costs as a share of their income, since the home may be paid for. On the other hand, medical expenses may take a much higher share of household income, especially for the older seniors.

4. Data, Methods & Organization of Analysis

To directly examine heating burdens for Spokane County, one needs accurate heating costs and income data for each household. Ideally, this would be provided by a household census; however, a representative sample, such as the RECS, would work. The research team did not have access to either tool. An alternate, less detailed method uses heating cost and/or income data at the lowest geographical unit possible, following the "group" approach discussed in section 3.2. This method was employed in two variants for this study.

The first looks at Census income data. The smallest unit for which income data could be secured was the census tract.[7] The goal of this approach is to produce a current snapshot of the distribution of household income for each census tract in the County. In this way, estimates of the number of households below certain income levels can be developed. These numbers, for those "at risk," are viewed as equivalent to the number of households facing an energy burden. As noted by the APPRISE (2005) study, "Households with incomes less than $20,000 per year represent over 95% of all households that have a high home energy burden. Almost two thirds of households with incomes below $10,000 are characterized as having a high home energy burden." [8] In other words, if one can determine the number of low income households, one has a fairly accurate estimate of households facing heating burdens.

To complete this analysis for Spokane County, the research team used income data from the 2000 Census (actually 1999) as the base. Income levels for all households in each tract are then "brought forward" to the present via the techniques described in section 5.1. The result is a current estimate of households who qualify for LIHEAP or LIRAP assistance. A by-product of the estimate of total at-risk households is an estimate of the number of at-risk households with at least one member age 65 or over. This is taken up in section 5.3.

The extension of this technique to the near future is taken up in section 5.5. Techniques employed in this section are largely those of extrapolation of historical trends, in both a linear and non-linear way.

The second variant of the group approach tackles the creation of average heating costs in census tracts. This necessitated securing source data on heating costs from the County's electric and gas utilities. The research team was able to do this with data from three of the five utilities, representing the vast majority of households. The calculation, however, of heating costs from these records was hardly straightforward. First, households may use two utilities, one for electricity and one for natural gas (Avista), but without the ability to match addresses, we could not identify them and calculate only heating costs. Second, households may use one utility for electricity but heat with fuel oil or propane gas. Since the research team had no source data from fuel oil or propane gas providers, we faced a similar inability to match records. As a result, census tract average electricity cost information from utilities other than Avista had to be adjusted to account for these "dual" utility households.

In the end, we were able to fashion a version of a "group" measure of energy share or burden for each census tract for 2008. (In the study, heating seasons are labeled by the year in which they end.) We emphasize, however, that this method does not yield the number of households in each census tract that face a heating burden, since we could not line up heating cost records with an income distribution. Further detail about the method is taken up in section 7.

Thanks to thorough and clean records kept by SNAP, the research team was able to analyze data for the subset of Spokane County "at risk"

households who have recently been served by SNAP. The results are characterized in section 6. This analysis, in contrast to the proxy techniques employed in other sections, yielded unambiguous burden data for three heating seasons: 2004, 2008 and 2009. Of particular note is the calculation of pre- and post-award heating burdens for households receiving SNAP assistance. Section 6 also displays the distribution of SNAP awards, by level of energy burden and zip code. Combined with the estimates of at-risk households in section 5, the SNAP numbers give a sense of the size of "unmet need," or of the number of eligible households who have not received heating assistance.

The final chapter considers the assumptions necessarily employed in the analysis, as well as the limitations of both methods and data. It concludes with a brief discussion on the validity of the study's estimates.

5. Estimating At-risk Households

Households with a high probability of qualifying for energy assistance funds are defined in this study as "at-risk households" (ARH). Under the current LIHEAP program, the income threshold for eligibility is set at 150% of the appropriate federal poverty level (the poverty level applied to the 150% adjustment is dependent on household size) or 60% of a state's median household income, whichever is higher.

5.1 Methodology for Estimating At-risk Households

The most complete data on the distribution of household income (HHI) by census tract comes from the 2000 census, which uses 16 income brackets for sorting occupied households by their 1999 HHI. Therefore, to generate annual estimates for the 2003-2008 periods, the 1999 share of total households in each income bracket for each tract is multiplied by annual estimates of total households in each tract. This means annual estimates of total households per tract for the 2003-2008 period are allocated over inflation adjusted income brackets using the bracket shares from the 2000 census. This approach assumes that the *share* of households in each inflation adjusted income bracket has not changed significantly since 1999, even though the number of households is not constant over time.

More formally, the estimation process is:

[1] $h_{i,c,t} = (H_{c,t})(S_{i,c,99})$

for i = 1,…,16 income brackets; c = 1,…,106 census tracts; and t = 2003,…,2008

Where:
$h_{i,c,t}$ is the estimated number of occupied households in inflation adjusted income bracket i in tract c at time t;
$H_{c,t}$ is the estimate of total occupied households in tract c at time t; and
$S_{i,C,99}$ is the share of total occupied households in income bracket i in tract c in 1999, as reported in the 2000 U.S. Census.

Therefore, it follows from equation [1]:

[2] $$H_{c,t} = \sum_{i=1}^{16} h_{i,c,t} \quad \text{and} \quad Z_t = \sum_{c=1}^{106} H_{c,t}$$

Where: Z_t is the total estimated occupied households in Spokane County at time t.

The annual estimates of occupied households by tract come from Washington's Office of Financial Management (OFM) for the 2003-2008 period. In order to adjust for the impact of inflation, the 1999 income brackets are increased using the Consumer Price Index (CPI) for cities in the western U.S. with fewer than 1.5 million people (the Western b/c index). The adjustment to the 1999 brackets for the years 2003-2008 was as follows:

[3] $B_{L,i,t} = (B_{L,99})(1 + F_t)$ and $B_{U,i,t} = (B_{U,99})(1 + F_t)$

Where:
$B_{Li,t}$ and $B_{U,i,,t}$ are the lower (L) and upper (U) income limits for bracket i in year t;
$B_{L,i,99}$ and $B_{U,i,99}$ are the lower and upper limits for bracket i in 1999; and
F_t is the total amount of inflation that has occurred between 1999 and year t.

A similar approach is used for estimating the share of at-risk households with a head of household 65 years or older (ARH65). However, since the OFM only estimates total households, an additional variable is added to equation [1] to estimate those households with a householder 65 years or older. This variable ($P_{c,99}$) is the share of 65 and over households in tract c in 1999 from the 2000 census. Thus, equation [1] becomes:

[4] $k_{i,c,t} = [(H_{c,t})(P_{c,99})](P_{i,c,99})$

for i = 1,…,16 income brackets; c = 1,…,106 tracts; and t = 2003,…,2008

Where:
$k_{i,c,t}$ is the estimated number of 65 and over occupied households in income bracket i in tract c at time t;
$H_{c,t}$ is the OFM estimate of total occupied households in tract c at time t;
$P_{c,99}$ is the share of total 65 and over occupied households in tract c in 1999; and
$P_{i,c,99}$ is the share of total 65 and over occupied households in income bracket i in tract c in 1999 as reported in the 2000 census.

In other words, the term $[(H_{c,t})(P_{c,99})]$ is an estimate of the total 65 and over households in tract c at time t. This is then multiplied by the 1999 share of 65 and over households in each income bracket in tract c to estimate $k_{i,c,t}$.[9]

The next step is to estimate the number of at-risk households (ARH), using the federal poverty lines (FPL) for each year since 1999. FPL levels increase as the number of people in a household does. Since the Census does not report data on individual households, the average household size is used to establish a poverty line that would apply *on average*. Spokane County's average household size for all households was approximately 2.4 people over the period of interest; consequently, the analysis uses the average of the three-person and two-person poverty levels. Likewise, since the average household size with a 65 or older householder is approximately 1.4 people, a similar approach is applied, using the poverty levels for householders 65 and over for one-person and two-person households.

These poverty lines are then inflated by 125% and 150%. The 125% adjustment reflects the current threshold used by SNAP, and the 150% reflects one of LIHEAP's legislated maximum thresholds. One additional threshold is established by applying LIHEAP's alternative maximum, defined as 60% of Washington's median household income (HHI). This threshold applies to all household types. (At the time of this writing, 2009 data on poverty thresholds, the CPI, and OFM household estimates were not available; therefore, ARH for 2009 could not be estimated using the approach described here.)
These adjusted poverty lines are then compared against the income brackets described by [3]. The numbers of households associated with income brackets at or below the adjusted FPL are then summed to estimate ARH in each census tract. In this approach, the highest applicable income bracket is the one in which the adjusted poverty line falls.[10] Therefore,

$$[5] \qquad r_{c,t} = \sum_{i=1}^{I} h_{i,c,t}$$

for c = 1,…,106 tracts; and t = 2003,…,2008

Where:
$r_{c,t}$ is the number of at-risk households (ARH) in tract c at time t;
I is the number of income brackets at or below the adjusted poverty line in tract c at time t; and
$h_{i,c,t}$ is the number of estimated households in the applicable income bracket in tract c at time t.

Use of the average poverty level for a 2- and 3-person household resulted in both the 125% and 150% adjusted FPL encompassing the first *three* income brackets (I = 3). In contrast, the 60% median HHI adjustment encompassed the first *five* brackets (I = 5). Summing across all tracts in each year, the county total of ARH is:

$$[6] \qquad R_t = \sum_{c=1}^{106} r_{c,t} \qquad \text{for } t = 2003,\ldots,2008$$

Where: R_t is the estimated county total of ARHs.

Likewise, for ARH65:

$$[7] \qquad e_{c,t} = \sum_{i=1}^{I} k_{i,c,t}$$

for c = 1,…,106 tracts and t = 2003,…,2008

Where:
$e_{c,t}$ is the number of ARH65 in tract c at time t;
I is the number of income brackets at or below the adjusted poverty line in tract c at time t; and
$k_{i,c,t}$ is the number of estimated households with at least one member age 65 or over in the applicable income bracket in tract c at time t.

Use of the average poverty level for a 1 and 2 person household (with a householder 65 and over) resulted in both the 125% and 150% FPL adjustment encompassing the first *two* income brackets (I = 2). In contrast, the 60% median HHI adjustment encompassed the first *five* brackets (I = 5). Therefore, as before, the county total of ARH65 would be:

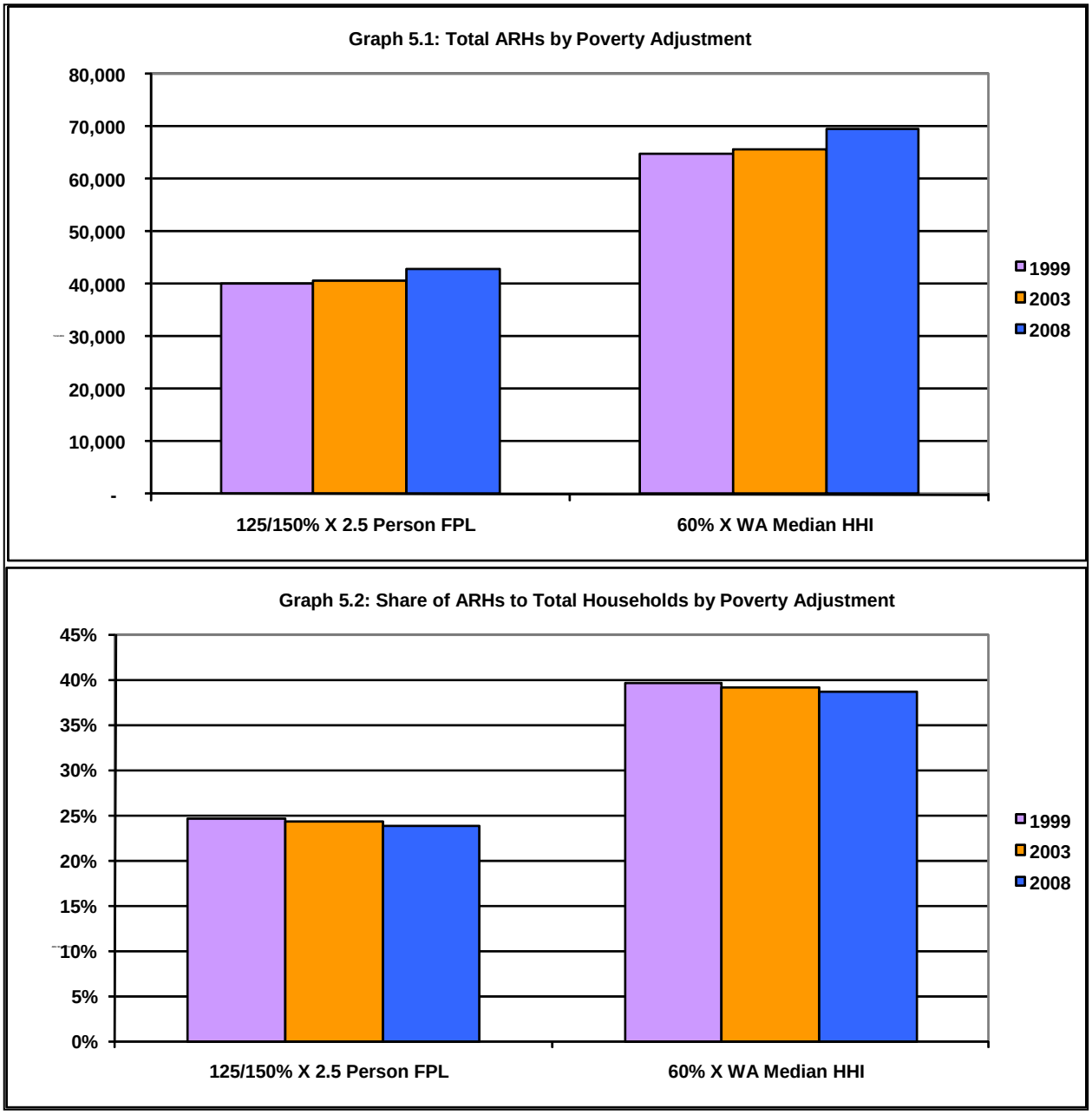
$$[8] \qquad E_t = \sum_{c=1}^{106} e_{c,t} \qquad \text{for t = 2003,…,2008}$$

Where: E_t is the estimated county total of ARH65.

5.2 ARH Estimation Results

Figure 5.1 (Graphs 5.1 and 5.2) shows the estimation of the number of at-risk households (ARH) in Spokane County. Graph 5.1 shows the absolute number of ARHs in 1999, 2003, and 2008; Graph 5.2 shows the share of ARHs to total county households in 1999 and 2008. As of 2008, there were approximately 43,000 ARHs at the 125/150% FPL adjustment and 69,700 at the 60% of HHI adjustment. The relatively sharp jump from 2003 to 2008 reflects a stronger than normal growth in county households starting in 2005. Although the absolute number of ARHs has increased since 1999 (7% to 7.5% depending on the FPL adjustment used), the estimated shares of ARH have not changed significantly since 1999. At-risk households represent about 24% and 39% of all households at the 125/150% and 60% adjustments, respectively.

Figure 5.1: Estimates of the Number of At-risk Households by Poverty Adjustment in 1999, 2003 and 2008



It is useful to compare these numbers to those from the 2008 LIHEAP evaluation study based on the 2001 Residential Energy Consumption Survey (RECS).[11] Using the actual eligibility standards used by states, the study found that about 21% of U.S. households qualified for LIHEAP assistance. This number is within the range of the County's estimated share of ARH shown in Figure 5.1.

A further check of this result can be made by comparing it to Washington State's total low-income household estimate provided by Apprise (2007, p. 4). For 2005, the study arrived at 452,252 households at or below the 150% FPL. No county break-out was given, however. Apportioning Spokane County's population share of the 2005 state total (7%) would yield 31,538. However, the County has been

characterized by a higher rate of poverty than the state. In 2005, the all-age poverty rate (100% FPL) in Spokane County was estimated at 14.4% vs. 11.9% for the State, or 21% higher.[12] After factoring in this adjustment, the County's poverty-adjusted population share is 8.4%. Applying this to the total reported by APPRISE yields 38,144 households.

While separated by three years, the results from this study and the one provided by this derivation from the APPRISE Washington State study are quite close. The only FPL rate available for the County is at the 100% level. Were the rates available for the 125% and 150% levels, the derived households total would certainly be higher.

In a look at the sub-county level, Figures 5.2, 5.3, and 5.4 show each tract's at-risk households as a share of total households in 2008, using the 125/150% adjusted FPL. The tract numbers are from the 2000 census. Appendix A provides the definition of the principle city/town abbreviations shown in parenthesis for each tract.[13] The tracts are arranged from highest to lowest shares, with the overall county share of 24% ARH shown as a red line in each graph.

The City of Spokane, reflecting its size, contains the largest number of tracts; however it also contains the tracts with the largest shares of ARH. Most of these tracts are located in the central, east-central, and northeast portions of the city. The City of Cheney (Figure 5.4) also has a relatively high percentage of ARH. In the case of both east-central Spokane and Cheney, this may reflect, in part, the influence of the university populations associated with Gonzaga and Eastern Washington Universities.

Figure 5.2: At-risk Households in City of Spokane Area at the 125/150% FPL Adjustment in 2008

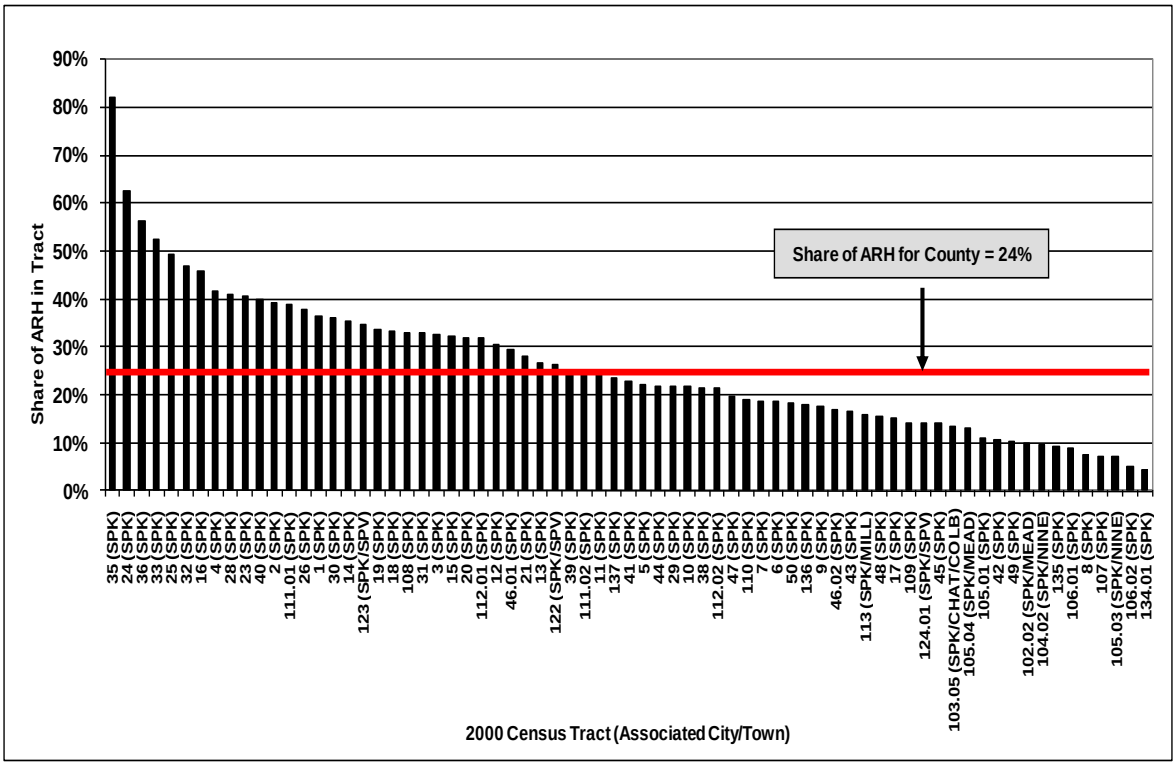


Figure 5.3: At-risk Households in City of Spokane Valley Area at the 125/150% FPL Adjustment in 2008

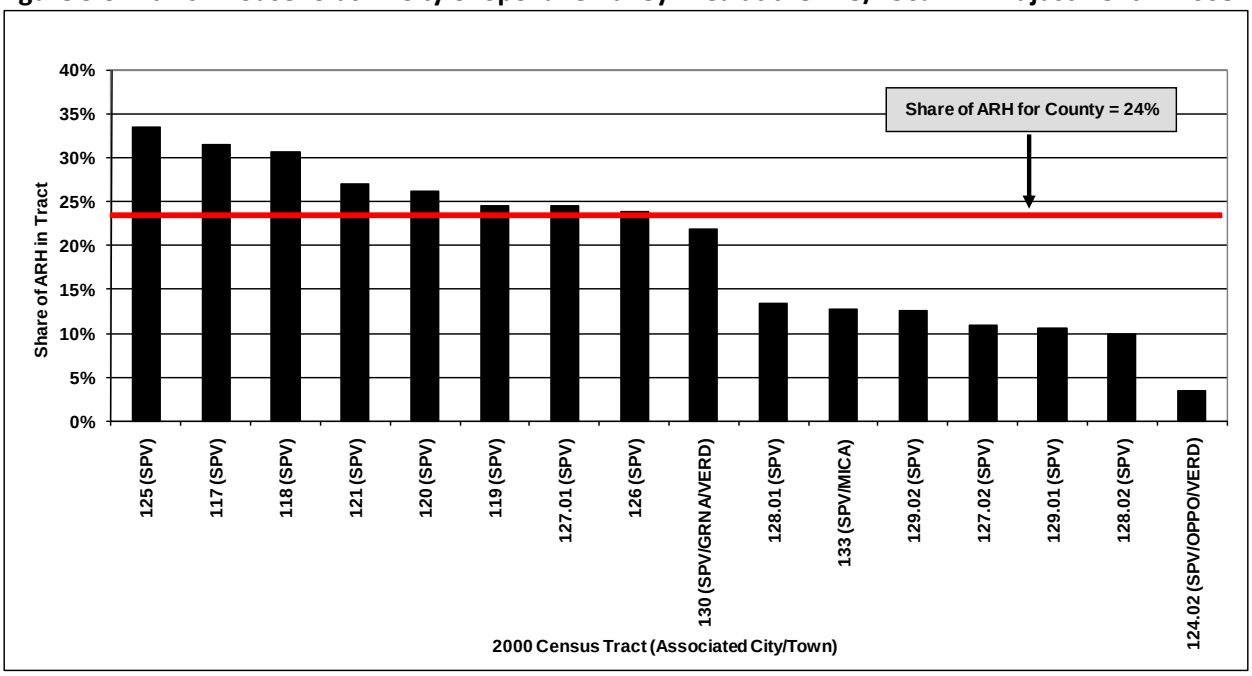


Figure 5.4: At Risk Households in Other County Areas at the 125/150% FPL Adjustment in 2008

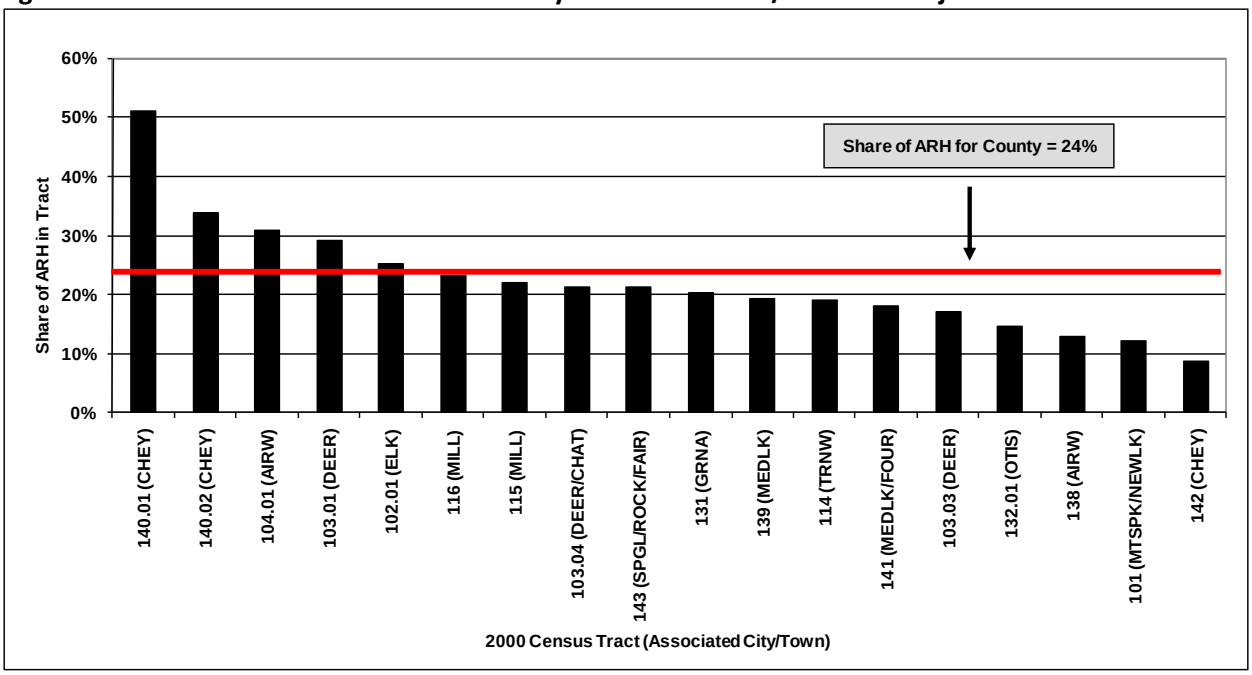
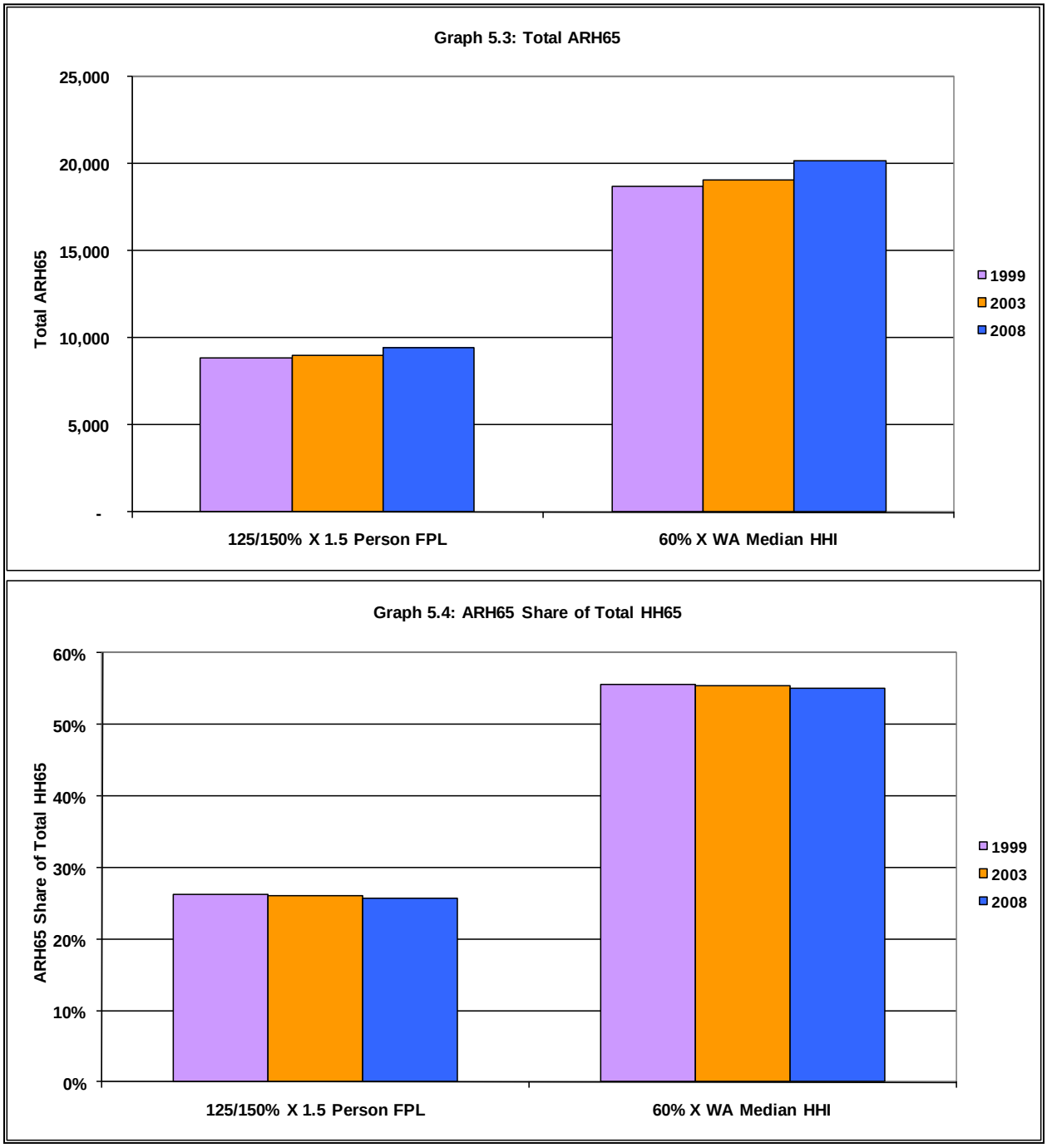


Figure 5.5 (Graphs 5.3 and 5.4) shows the absolute number of at-risk households with a householder age 65 or over (ARH65) in 1999, 2003, and 2008, as well as their share of total 65 and over households (HH65), at the 125/150% FPL adjustment and at 60% of household median income adjustment. As of 2008, there were approximately 9,400 ARH65 at

the 125/150% FPL adjustment and 17,000 at the 60% adjustment. In share terms, these estimates reflect 26% and 55% of total HH65.

Although the estimated number ARH65s has increased, the share of ARH65s to total HH65s has not changed significantly since 1999.

Figure 5.5: Estimates of the Number of At-risk Householders 65 and Over in 1999, 2003, and 2008



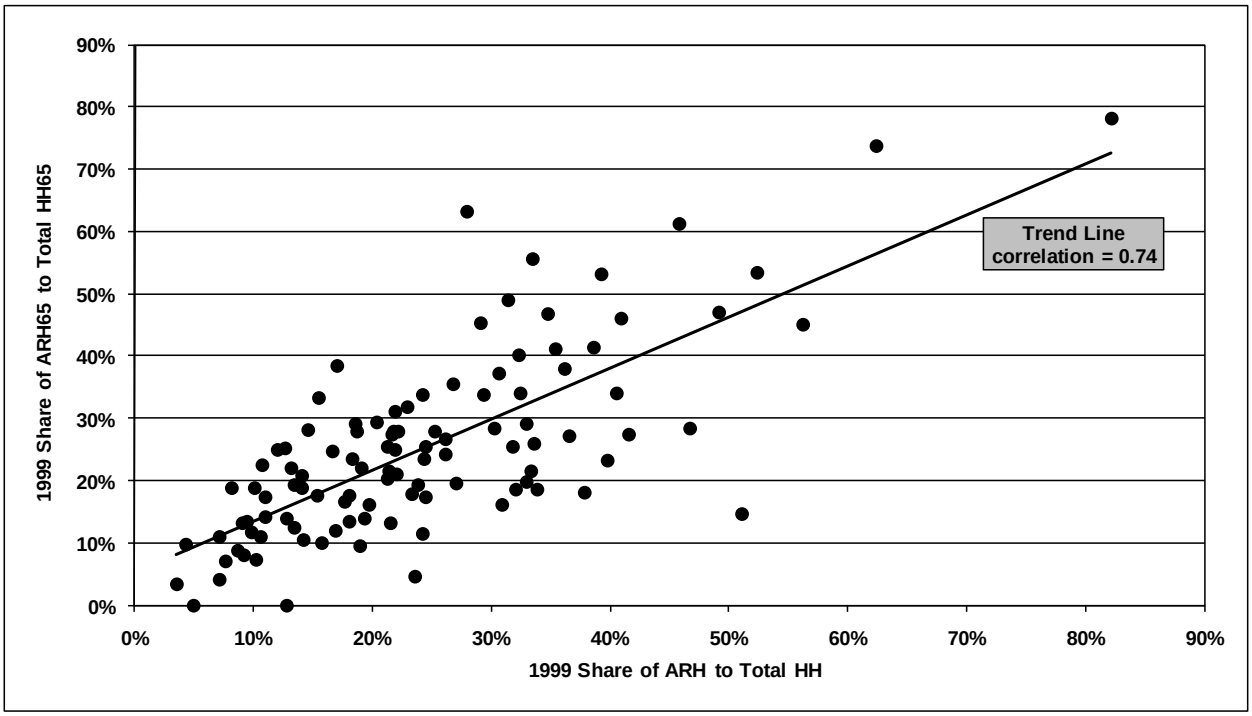
5.3 The Correlation between ARH and ARH65 Provides a Reasonable Estimate of the numbers of ARH65

Since one of LIHEAP's target demographic groups are at-risk households with individuals 65 years and over, it useful to explore the correlation between the share of all at-risk households (ARH) and at-risk households with a member age 65 or over (ARH65) by census tract. Figure 5.6 is a scatter graph of ARH and ARH65 for all tracts in Spokane County in 1999. Figure 5.6 clearly shows a positive and significant correlation between ARH and ARH65. The correlation coefficient between ARH and ARH65 is 0.74. In other words, tracts with a high share of ARH also tend to have a high share of ARH65. This implies that if the share of ARH is the only available indicator for an area (e.g., tracts, counties, cities, or states), then the share of ARH can also be used as an indicator of ARH

5.4 The Share of SNAP LIHEAP and LIRAP Households to Estimated ARH

Figure 5.7 (Graphs 5.5 and 5.6) shows the total number and share of household receiving heating assistance through LIHEAP and LIRAP since 2004, as distributed by SNAP[14] (Recall that heating seasons are labeled by the year in which they end.) SNAP households (SNAP HHs) receiving energy assistance through these programs are also compared to the estimated at-risk households and total county households (Graph 5.7).

Figure 5.6: 1999 Relationship between At-risk Households & At-risk Householders 65 and Over at the 125/150% Adjustment



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As mentioned in section 3.1, SNAP currently uses a 125% adjustment for establishing household eligibility for heating assistance.

Graph 5.5 records a dramatic increase in SNAP households, one that reverses a downward trend that started in 2006. Note, however, that the number of LIRAP recipients increased only slightly in 2009. Nearly all the increase in the past heating year was attributable to LIHEAP.

The path of the two most recent heating years depicted in Graph 5.6 reveals that LIHEAP and LIRAP accounted for about 70% and 30% of SNAP HHs in 2008, respectively. Due, however, to an increase of funds through the 2008/2009 federal stimulus program, LIHEAP's share increased to 80%. Graph 5.7 shows that SNAP served about 22% of at-risk households at the 125%/150% adjustment and 14% at the 60% adjustment in 2008.

Over the years covered, SNAP has covered 22-26% of the eligible households, as measured by the FPL rule. It has covered 14-16% of eligible households, as measured by the median household income rule.

Graph 5.7 shows that relative to all County households, SNAP-assisted households have accounted for about 5% of households. If the 2009 projection of ARH (discussed in the following section) is used as a base, then SNAP may have served around 30% of eligible households at the 125%/150% adjustment and 19% of eligible households at the 60% adjustment.

Figure 5.7: SNAP LIHEAP+LIRAP Households from 2004-2009

The 2005 LIHEAP evaluation study found about 13% of eligible households in 2001 received LIHEAP assistance. SNAP's higher share of households served reflects the decision to set the local eligibility threshold at 125% of the applicable FPL, which is below LIHEAP's legislated maximums, and Avista's LIRAP dollars.

5.5 Projections of ARH for 2009-2012

Section 5 is concluded by considering annual projections of Spokane County's at-risk households (ARH) for the 2009-2012 periods. Two different approaches are used to generate projections for each of the three poverty line adjustments. The first approach generates projections as follows:

$$[9] \qquad R_{08+t} = [(H_{08})(1 + g)^t](W_{08,a})$$

for t = 1,…,4 at poverty adjustment a = 125/150%; and 60% of HHI.

Where:
R_{08+t} is the projected number of the County's ARH at time 2008+t;
H_{08} is the total number of OFM occupied households in 2008;
g is the average annual geometric growth rate of occupied households from 1999-2008 (g=0.012); and
$W_{08,a}$ is the estimated share of ARH in 2008 to total HH in 2008 at poverty level adjustment a.

This "fixed share method" assumes that $W_{08,a}$ is a reasonable approximation for $W_{08+t,a}$ given that t is not large.

The second method uses regression analysis to map the relationship between 1999 median HHI and the 1999 share of ARHs (W_{99}) in each of Washington's 39 counties, again using the 125%/150% and 200% adjustments. The regression equation is used to estimate W for each county is as follows:

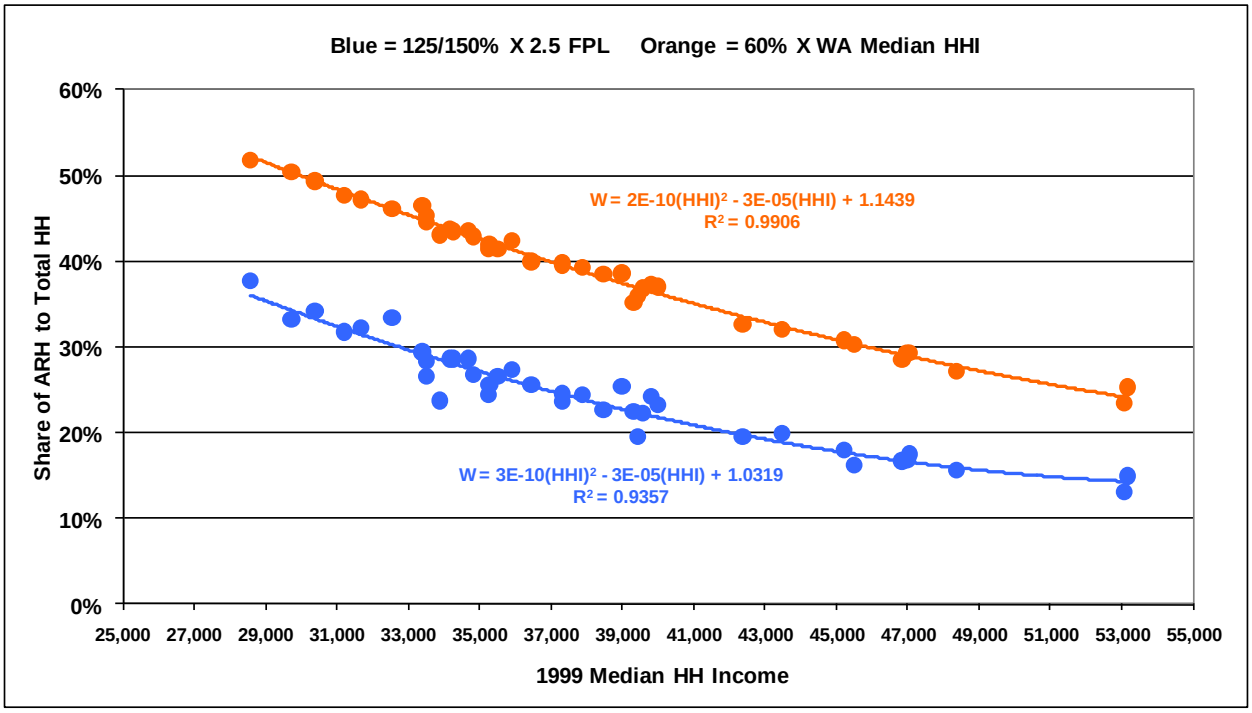
$$[10] \qquad W^*_{j,99,a} = b_0 + b_1(HHI_{j,99}) + b_2(HHI_{j,99})^2$$

for j = 1,…,39 counties at poverty adjustment a= 125/150% and 60% of HHI.

Where:
$W^*_{j,99,a}$ is the regression estimate of $W_{j,99}$ at poverty adjustment a;
$HHI_{j,99}$ is county j's median household income in 1999.

These estimated regression equations are shown in Figure 5.8. Each of these two regression equations is then used to estimate the county's future share (W^*) by simply projecting forward HHI deflated to 1999 dollars. In this case, the HHI projection for this forecast is generated by taking the average of real median HHI (in 1999 dollars) over the 1999-2007 period for Spokane County (the average used is $37,900).[xv] This average of HHI projection for 2008 to 2012 is inserted into equation [8] to generate W^*_{jta} for 2008 to 2012.

Figure 5.8: Regression Relationship between ARH and Median Household Income across 39 Washington Counties in 1999



Therefore, equation [9] becomes:

[11] $R_{08+t} = [(H_{08})(1 + g)^t](W^*_{j,t,a})$

for t = 0,…,4 at poverty adjustment a = 125/150%
and 60% of HHI,
Where t = 0 is the projection for 2008, t = 1 for 2009, and so on.

The advantage of equation [11] is that it can be used to simulate the impact of changes in real household income (HHI) on a county's ARH. However, this approach assumes that the functional form expressed by equation [10] has not fundamentally changed since 1999.

Table 5.1 presents the projections from both methods. Both methods generate similar results, and suggest that at the 125/150% FPL adjustment and the 60% of HHI adjustment, the number of ARH will increase by approximately 550 and 850 households per year, respectively. The larger household growth associated with the 60% adjustment reflects the impact of the larger eligible base estimated for 2008.

Table 5.1: Projections of At Risk Households in Spokane County for 2009-2012

Fixed Share Projection Method, Equation [9]				
Year	**a = 125/150% of FPL**	**a = 60% of HHI**	**a = 125/150% of FPL: Change**	**a = 60% of HHI: Change**
2008	43,016	69,706		
2009	43,533	70,542	516	836
2010	44,055	71,389	522	847
2011	44,584	72,246	529	857
2012	45,119	73,113	535	867
Regression Projection Method, Equations [10] and [11]				
Year	**a = 125/150% of FPL**	**a = 60% of HHI**	**a = 125/150% Change**	**a = 60% of HHI Change**
2008	44,532	69,299		
2009	45,066	70,130	534	832
2010	45,607	70,972	541	842
2011	46,154	71,824	547	852
2012	46,708	72,685	554	862

6. Analysis of Spokane County Households Assisted by LIHEAP & LIRAP

SNAP's database of LIHEAP and LIRAP recipients in Spokane County provides both a cross-sectional and time series picture of the heat burden borne by low-income households. Each observation in the database represents an individual household and can be broken out by household characteristics, such as the presence of children 0-5 years (HH5); adults 60 years or older (HH60); handicapped individuals (HHHC); and household location by zip code. In addition, as the electronic database goes back to 2004, the time dimension of heat burden can be examined.

However, it is important to remember that the database does not consist of a single household cohort followed each year. The SNAP records contain those households who qualified for LIHEAP assistance, and they may or may not be in multiple years of the database. Also, since income is self-reported on a monthly basis, a reporting bias of an unknown size is likely reflected in the data. To convert monthly income into an annual estimate, each household's reported income is multiplied by 12.

Since all SNAP recipients show high heating expenditures relative to their income, the rates in this section are all expressed as burdens. As noted in section 3, analysts of the national LIHEAP program estimate that a "high" burden occurs when heating and cooling costs are greater than or equal to 4.3% of gross HHI, while a "moderate" burden is more than 2.6% of HHI, but less than 4.3% HHI.[16] Therefore, if the heat burden of a SNAP-assisted household is above these thresholds, then it is likely that their energy burden for heating ***and*** cooling is higher.

6.1 Summary Statistics of Heat Burden, 2004 – 2009

Tables 6.1 through 6.3 provide summary statistics for each of the relevant groups of households in heating years 2004, 2008, and 2009. (In the study, heating seasons are labeled by the year in which they end.) Following the "individual" methodology of the 2005 LIHEAP evaluation study, all burden statistics in Tables 6.1-6.3 are based on calculating heating burdens for individual households and then calculating the median burdens for each group under consideration. With the exception of household size, the median, rather than mean, is used because a comparison of the mean and median of gross HHI, heating costs and heat burden showed relatively skewed distributions in all years. As a result, the median is a better measure for characterizing a "typical" SNAP household. Recall that the median reflects the heat burden that 50% of households are above and 50% are below.

The two measures of heat burden are **gross heat burden** and **net heat burden**. The gross heat burden is calculated for only those households that report positive income, and reflects the heat burden in the *absence* of energy assistance. In contrast, net heat burden is calculated as annual heating costs less energy assistance, divided by gross HHI. Finally, the sub-groups in each table are not mutually exclusive, in that some households with children may also be represented in the households with adults 60 years or over or handicapped persons.

Table 6.1: Analysis of SNAP (LIHEAP+LIRAP) Households, Heating Season 2004

2004 SNAP Population	All HH	HH with Children 0 to 5 Yrs.	HH with Persons 60 and Over	HH with Handicapped
Number of HHs	8,785	2,512	1,444	3,621
Share of HHs	100%	29%	16%	41%
Mean HH Size	2.72	4.16	1.61	2.10
Number of LIHEAP HHs	5,604	1,521	959	2,406
Share of All HHs	64%	61%	66%	66%
Mean LIHEAP HH Size	2.65	4.15	1.56	2.02
Number of LIRAP HHs*	3,181	991	485	1,215
Share of All HHs*	36%	39%	34%	34%
Mean LIRAP HH Size*	2.85	4.17	1.71	2.25
All HH Median Annual Heating Bill, $	580	633	556	550
LIHEAP HH Median Annual Heating Bill, $	585	632	583	558
LIRAP HH Median Annual Heating Bill, $*	572	633	516	550
All HH Median Monthly Income, $	790	1,059	721	708
All HH Implied Annual Median Income, $	9,482	12,705	8,648	8,492
LIHEAP HH Median Monthly Income, $	770	1,067	712	688
LIHEAP HH Implied Annual Median	9,242	12,800	8,544	8,250
LIRAP HH Median Monthly Income, $*	829	1,047	729	743
LIRAP HH Implied Annual Median Income,	9,948	12,564	8,748	8,916
Median Annual LIHEAP+LIRAP HH Benefit,	467	530	437	435
Median Annual LIHEAP HH Benefit, $	460	513	452	431
Median Annual LIRAP HH Benefit, $*	481	538	421	442
HH Heat Burden, Income > 0:				
All HH Gross Median	5.4%	4.7%	5.9%	5.6%
All HH Net Median	0.8%	0.7%	1.1%	0.9%
LIHEAP HH Gross Median	5.5%	4.6%	6.2%	5.8%
LIHEAP HH Net Median	0.9%	0.7%	1.1%	1.0%
LIRAP HH Gross Median*	5.2%	4.8%	5.6%	5.3%
LIRAP HH Net Median*	0.8%	0.7%	1.0%	0.9%
HH reporting no income	243	58	8	36

* LIRAP households include 216 households that received an Avista energy tax rebate in lieu of a traditional LIRAP subsidy.

Table 6.2: Analysis of SNAP (LIHEAP+LIRAP) Households, Heating Season 2008

2008 SNAP Population	All HH	HH with Children 0 to 5 Yrs.	HH with Persons 60 and Over	HH with Handicapped
Number of HHs	9,193	2,364	1,843	4,447
Share of All HHs	100%	26%	20%	48%
Mean HH Size	2.52	4.19	1.48	2.01
Number of LIHEAP HHs	6,569	1,688	1,308	3,139
Share of All HHs	71%	71%	71%	71%
Mean LIHEAP HH Size	2.51	4.18	1.46	2.00
Number of LIRAP HHs	2,624	676	535	1,308
Share of All HHs	29%	29%	29%	29%
Mean LIRAP HH Size	2.54	4.21	1.51	2.02
All HH Median Annual Heating Bill, $	695	783	684	669
LIHEAP HH Median Annual Heating Bill, $	701	790	692	682
LIRAP HH Median Annual Heating Bill, $	686	769	630	637
All HH Median Monthly Income, $	870	1,259	789	780
All HH Implied Annual Median Income, $	10,444	15,102	9,468	9,360
LIHEAP HH Median Monthly Income, $	872	1,264	786	781
LIHEAP HH Implied Annual Median	10,464	15,162	9,437	9,372
LIRAP HH Median Monthly Income, $	860	1,251	796	775
LIRAP HH Implied Annual Median	10,324	15,006	9,552	9,300
Median Annual LIHEAP+LIRAP HH	519	608	469	477
Median Annual LIHEAP HH Benefit, $	516	611	483	474
Median Annual LIRAP HH Benefit, $	529	604	441	487
HH Heat Burden, Income > 0:				
All HH Gross Median	5.9%	5.0%	6.5%	6.1%
All HH Net Median	1.4%	1.1%	1.8%	1.5%
LIHEAP HH Gross Median	6.1%	5.0%	6.7%	6.3%
LIHEAP HH Net Median	1.5%	1.1%	1.9%	1.6%
LIRAP HH Gross Median	5.7%	4.9%	6.0%	5.8%
LIRAP HH Net Median	1.3%	1.1%	1.5%	1.4%
HH reporting no income	134	24	6	26

Table 6.3: Analysis of SNAP (LIHEAP+LIRAP) Households, Heating Season 2009

2009 SNAP Population	All HH	HH with Children 0 to 5 Yrs.	HH with Persons 60 and Over	HH with Handicapped
Number of HHs	13,140	3,615	2,326	5,469
Share of All HHs	100%	28%	18%	42%
Mean HH Size	2.59	4.13	1.53	2.04
Number of LIHEAP HHs	10,459	2,725	2,067	4,648
Share of All HHs	80%	75%	89%	85%
Mean LIHEAP HH Size	2.55	4.19	1.50	1.99
Number of LIRAP HHs	2,681	890	259	821
Share of All HHs	20%	25%	11%	15%
Mean LIRAP HH Size	2.75	3.96	1.78	2.27
All HH Median Annual Heating Bill, $	774	854	710	715
LIHEAP HH Median Annual Heating Bill, $	767	851	710	710
LIRAP HH Median Annual Heating Bill, $	794	866	792	750
All HH Median Monthly Income, $	931	1,292	803	821
All HH Implied Annual Median Income, $	11,172	15,500	9,637	9,852
LIHEAP HH Median Monthly Income, $	907	1,291	812	803
LIHEAP HH Implied Annual Median	10,884	15,495	9,744	9,637
LIRAP HH Median Monthly Income, $	1,030	1,296	931	919
LIRAP HH Implied Annual Median Income,	12,360	15,554	11,172	11,033
Median Annual LIHEAP+LIRAP HH Benefit,	557	650	499	507
Median Annual LIHEAP HH Benefit, $	549	652	492	500
Median Annual LIRAP HH Benefit, $	586	644	546	548
HH Heat Burden, Income > 0:				
All HH Gross Median	6.1%	5.3%	6.9%	6.5%
All HH Net Median	1.4%	1.1%	1.9%	1.6%
LIHEAP HH Gross Median	6.2%	5.3%	6.9%	6.6%
LIHEAP HH Net Median	1.4%	1.1%	1.9%	1.6%
LIRAP HH Gross Median	5.9%	5.4%	6.5%	6.2%
LIRAP HH Net Median	1.4%	1.2%	1.8%	1.5%
HH reporting no income	247	51	9	39

An inspection of the summary statistics above the grey bar in Tables 6.1-6.3 reveals few differences between the financial characteristics of SNAP, LIHEAP, and LIRAP households. This is not surprising, as LIRAP's eligibility rules are the same as for LIHEAP. The similarity between the two participants of the two programs also extends to each of the sub-categories.

An examination of the calculations in the lines below the grey bar of Tables 6.1 and 6.2 shows an increase in the median *gross* heat burden between 2004 and 2008. Between the two heating seasons, the gross median heat burden for all SNAP-assisted households increased from 5.4% to 5.9%, or about 0.5% points. A similar increase in the median heat burden was observed for LIHEAP and LIRAP households, and for each of the three sub-groups. This is not surprising given the run-up in energy prices between 2004 and 2008.

A comparison of Tables 6.2 and 6.3 depicts only slight increase in gross heat burden between heating seasons 2008 and 2009. However, since employment declines accelerated in the spring and summer of 2009, the recession's impact on HHI (the denominator of heat burden) may not be fully captured by the 2009 data. As a benchmark, the gross median heat burden for all U.S. LIHEAP households in 2006 was 7.1% (2006 LIHEAP Home Energy Notebook, p. 7, Table 2-4). This suggests that the heat burden of SNAP households is lower by about one percentage point.

Within the sub-groups, HH60 and HHHC have higher burdens, compared to all SNAP households and those with very young children (HH5). Nevertheless, all of the groups show a gross median heat burden higher than the 4.3% threshold defined by LIHEAP as a "high" heating and cooling burden. This suggests that in the absence of LIHEAP, the typical SNAP household would be severely stressed if all energy costs were considered.

Tables 6.1 and 6.2 also demonstrate that between heating seasons 2004 and 2008 the *net* median heating burden for all categories increased approximately 1.6 times. This reflects an increasing share of heating costs to gross household income (gross burden), and a stable or declining share of LIHEAP benefits to gross HHI. Nevertheless, in both years, the median net burden was less than the lower end LIHEAP threshold of 2.6% that defines a moderate burden. In the past two heating seasons, there was little change in net heat burdens.

Table 6.4 presents a comparison of four growth rates for each category of SNAP-assisted households for the 2004 and 2009 periods: in median annual HHI, the growth in median annual energy assistance benefit, in the total growth of the median annual heating bill, and in the CPI inflation rate for Western b/c cities. Over 2004-2008 (the period of rising energy prices), the median heating bill for all SNAP households grew by 20% while median HHI only grew by 10%. A similar pattern exists for the three sub-categories of SNAP-assisted households.

For all SNAP-assisted households and for each sub-category, the median assistance benefit grew more slowly than or just kept pace with median HHI. Finally, with the exception of households with young children (HH5), inflation exceeded median HHI growth, which suggests a general contraction in the budget constraints of SNAP recipients. (CPI inflation, *excluding* energy costs, grew at or below median household income growth.) Although some caution is needed because the SNAP data do not follow a single cohort through time, the evidence suggests a material deterioration from 2004 to 2008 in the financial position of a typical SNAP recipient household.

Table 6.4: Growth Analysis of SNAP (LIHEAP+LIRAP) Households, Heating Seasons 2004 to 2009

% Change in Values 2004-2008 (Period of Rising Energy Prices)	**All HH**	**HH with Children 0 to 5 Yrs.**	**HH with Persons 60 and Over**	**HH with Handicapped**
Annual Median Income	10%	19%	9%	10%
Median Annual Energy benefit	11%	15%	7%	10%
Median Annual Heating Bill	20%	24%	23%	22%
CPI West b/c Index	13%	13%	13%	13%
CPI West b/c Index, Less Energy	10%	10%	10%	10%
% Change in Values 2008-2009 (Period of a Deepening Recession)	**All HH**	**HH with Children 0 to 5 Yrs.**	**HH with Persons 60 and Over**	**HH with Handicapped**
Annual Median Income	7%	3%	2%	5%
Median Annual Energy benefit	7%	7%	6%	6%
Median Annual Heating Bill	11%	9%	4%	7%
CPI West b/c Index (1st Half of 2008-09)	-1%	-1%	-1%	-1%
CPI West b/c Index, Less Energy (1st Half of 2008-09)	2%	2%	2%	2%

Note: Growth rates for median income, energy benefit, and heating bill are calculated by taking the percentage change from 2004 to 2008 and 2008 to 2009.

An examination of the two most recent heating seasons (a period of a deepening recession) reveals that the median heating bill for all SNAP households grew by 11%, while median household income (HHI) grew by 7%. As before, a similar pattern also exists for the three sub-categories. Unlike the 2004-2008 period however, the median assistance benefit grew faster or just kept pace with median HHI for all categories, while inflation was below median HHI growth. In fact, the CPI data for the first six months of 2009 shows deflation, due in large part to decline in energy prices. Excluding energy, consumer inflation is running around 2%, which is at or below median HHI growth.

Whether or not this is providing any real budget relief to Spokane County at-risk households depends on the how strongly the unemployment (or underemployment) impacts of the recession are being felt.

In addition, as was noted above, because the SNAP data do not follow a single cohort through time, the robust income growth (7% for all SNAP households) over heating season 2009 may reflect the combined impact of higher-income households seeking energy assistance due to the recession and the recent expansion of the assistance dollars. In fact, a careful examination of Tables 6.2 and 6.3 reveals that

from 2008 to 2009, the median HHI of all LIRAP households increased by 20% while median HHI of all LIHEAP households increased by only 4%. As a result, the median monthly income differential between LIHEAP and LIRAP households went from -$59 in 2004 and +$12 in 2008, to -$123 in 2009. That is, LIRAP households show significantly higher monthly income in 2009. This means, unlike previous years, LIRAP dollars in the most recent heating season were more frequently allocated to households with incomes higher than those funded with LIHEAP dollars.

6.2 Distributional Analysis of Heat Burden by Household in Three Recent Heating Years

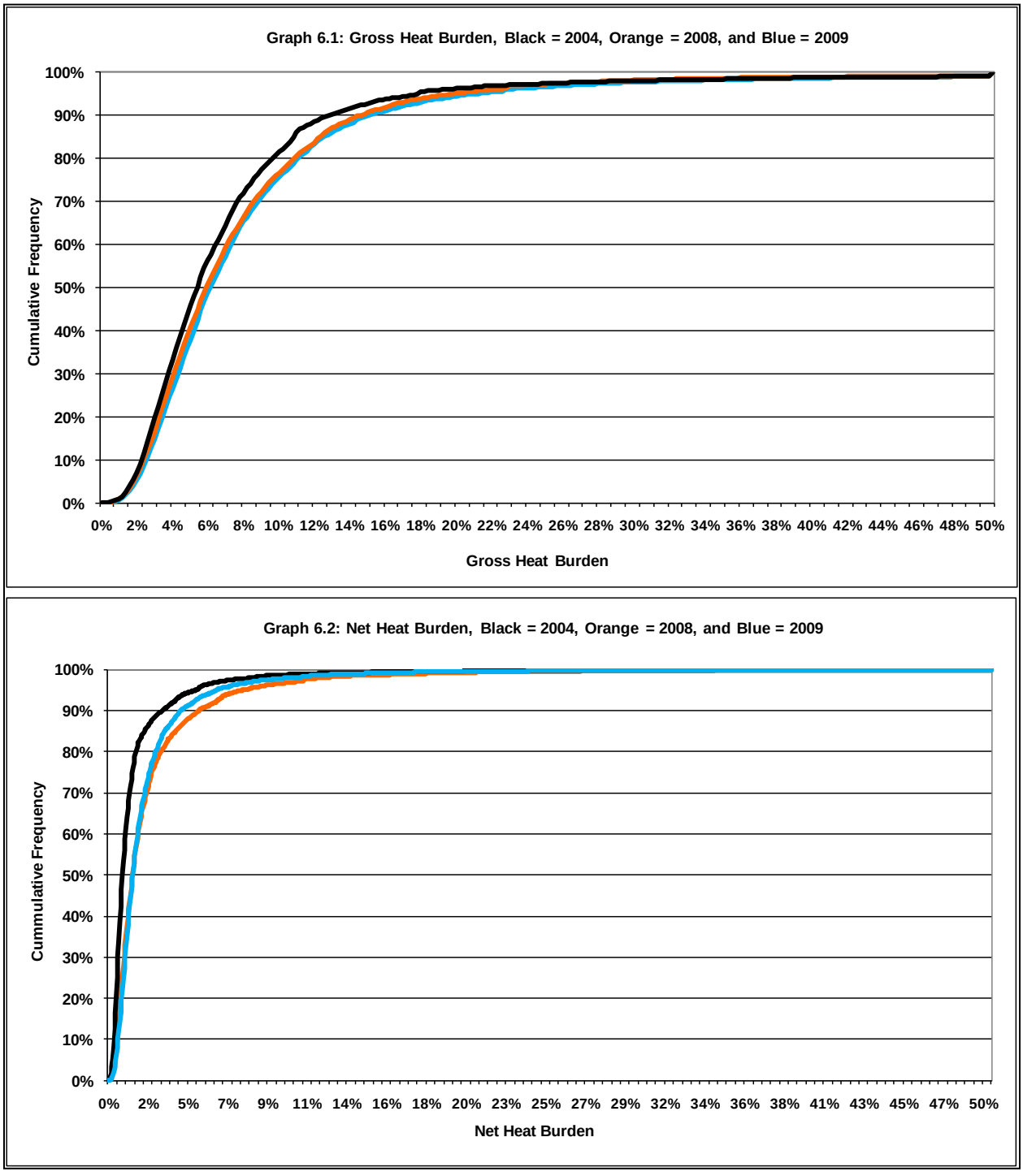
To obtain a better picture of the range and distribution of heat burdens, Figures 6.1 and 6.2 examine the distribution of heat burdens across all SNAP HH by individual households and geographic location. Here, geographic location is defined by a SNAP HH's five-digit zip code.

Figure 6.1 (Graphs 6.1 and 6.2) shows the cumulative frequency distribution for gross and net heat burdens in 2004, 2008, and 2009. Here, a cumulative frequency distribution shows how quickly the total number of SNAP-assisted households increases as the heating burden increases. A flatter slope of the line, as in Graph 6.1, indicates that it isn't until a gross burden of 12% that the vast majority, say 90%, of the households are accounted for. Equivalently, the remaining 10% of SNAP-assisted households reported a gross heating burden greater than 12% in 2004. A steeper slope to the line, as in Graph 6.2, implies that the vast majority of SNAP recipients faced a low net heating burden in all three heating years. For example, about 90% of SNAP recipients showed a net heating burden of less than 2% in 2004. With an adequately-funded program and accurate qualification of households, a difference in slopes of the gross and net heating burden curves should be the outcome.

Note further that in a cumulative frequency distribution, 50% on the vertical axis corresponds to the median heat burden on the horizontal axis. For example, imagine taking a pencil and placing its point on 50% on the vertical axis, and then drawing a horizontal line straight across to the black line (representing 2004). Next, imagine drawing a line straight down from this point on the black line to the horizontal axis. On the horizontal axis the pencil would touch the median heat burden for 2004, where 50% of households are above and below this number (the median value is shown in Table 6.1). The same process could also be applied to the orange and blue lines which reflect heating seasons 2008 and 2009. Finally, also note that the last heat burden bin (unit) in Figure 6.1 is for all burdens more than 50%.

Figure 6.1 reveals that both the gross and net heat burdens significantly shifted to the right between the 2004 and 2008 heating seasons. In other words, the burdens increased for SNAP recipients. Between the last two seasons, there was slight rightward shift in the gross burden, while the net heat burden was little changed. Between 2004 and 2008, most of the shift in gross heat burden occurred in the 4% to 25% burden range; for net heat burden, the range was 1% to 15%. Both of these shifts are consistent with the median changes in Tables 6.1-6.3, and imply higher heat burdens were felt by more than 90% of the households. As of the most recent season, about 69% of SNAP households had a gross heat burden in excess of 4.3% while 10% had a net heat burden in excess of 4.3%. In 2004, these same values where 61% and 6%, respectively.

Figure 6.1: Cumulative Frequency Distribution of Heating Burden of SNAP Households in Heating Seasons 2004, 2008 & 2009



Note: 2004 is the 2003-04 heating season, 2008 is the 200-08 heating season, and 2009 is the 2008-09 heating season.

Figures 6.2 and 6.3 show a distributional analysis by zip code. Figure 6.2 shows the share of SNAP households in each reported zip code in the same three heating seasons, starting

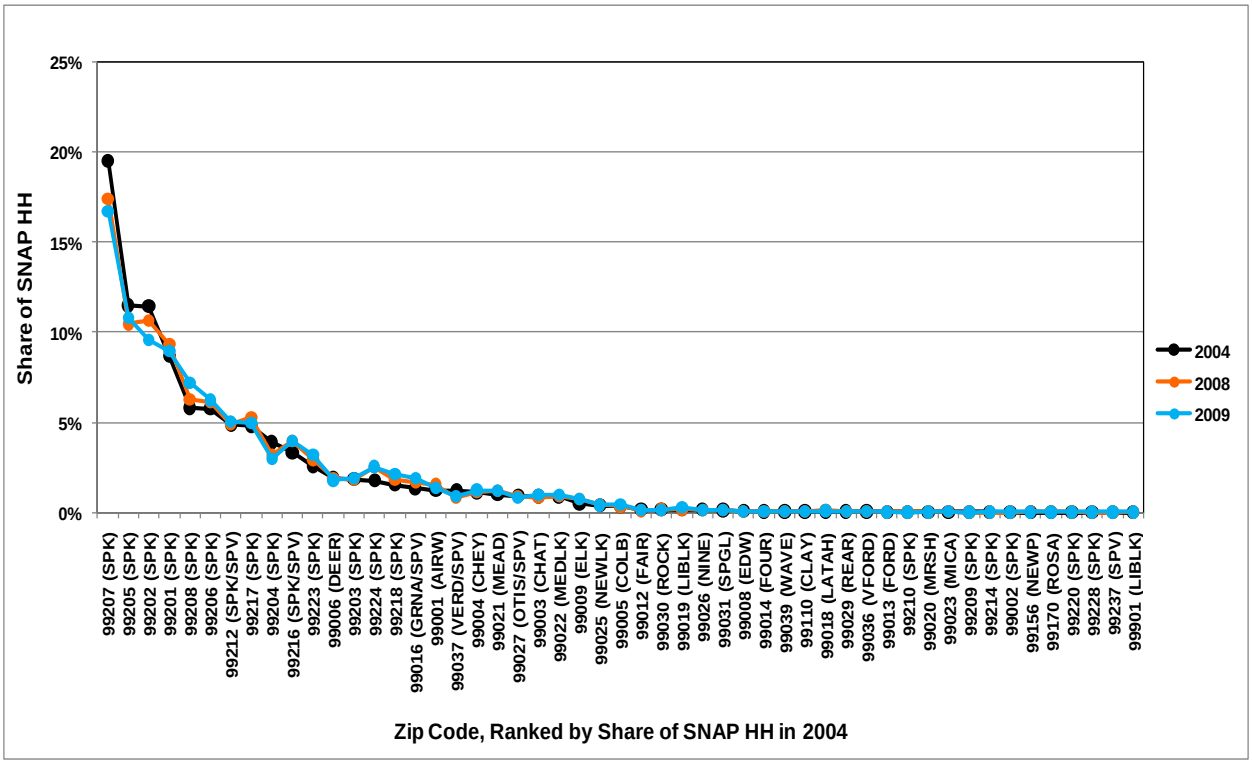
from the zip code with the largest share of households in 2004. Figure 6.3 shows the median heat burden in each reported zip code in the three seasons (Graph 6.3), starting with the zip code with the largest share of households in 2004 (see Figure 6.2). Graph 6.4 reproduces Graph 6.3 to zip code 99031 (Spangle, WA area). Appendix A provides the definition of city/town abbreviations shown in parenthesis for each zip code.[17]

Graph 6.2 reveals that in all three seasons, the top four and top nine zip codes account for approximately 50% and 75% of SNAP-assisted households, respectively, and are largely located in the City of Spokane. It also shows there has been little change in the zip code shares between 2004 and 2009. The top 15 zip codes represent the urban core areas of the City of Spokane and Spokane Valley. The remaining codes reflect the less urbanized areas of the County.

Figure 6.3 show that Spokane County zip codes with the highest share of SNAP households also have the lowest heat burdens. That is, starting from the first zip code (99207) there is a slight upward trend in the median heat burden in both years. This suggests that household heat burden is slightly higher in less urbanized areas, perhaps reflecting differences in housing and heating options, as well as income earning opportunities.

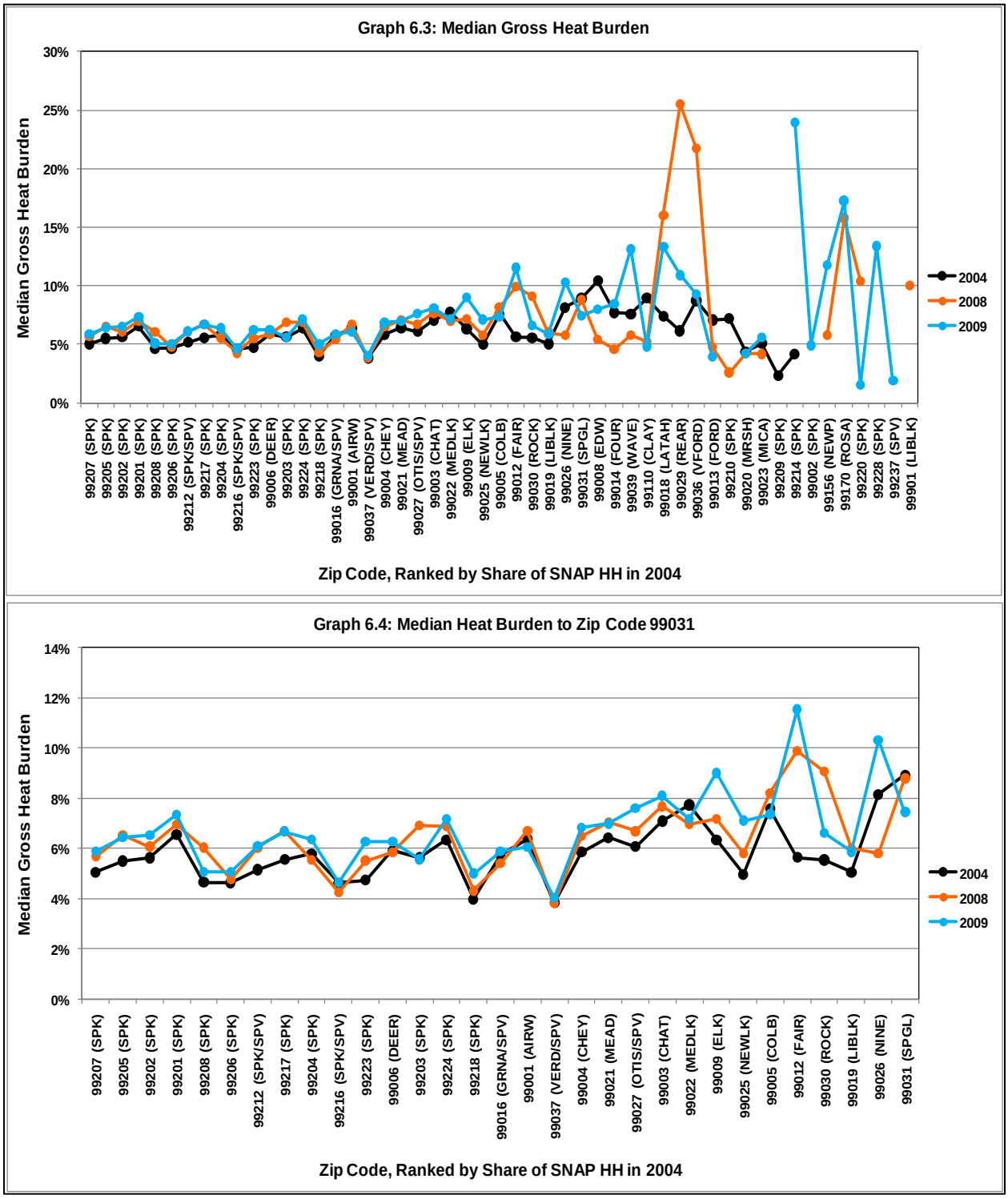
Some caution is needed in interpreting the median heat burden in zip codes after 99031, however, since the number of assisted households in each of these zip codes is very small—typically five or fewer households. Nevertheless, Graph 6.4 clearly shows this trend out to zip code 99031. This suggests that rural and urban households may face different heat burdens and, therefore, urban household heat burdens cannot necessarily be used to directly infer the level of rural heat burdens.

Figure 6.2: Distribution of SNAP LIHEAP+LIRAP) Households by Zip Code in Heating Seasons 2004-2009



Note: 2004 is the 2003-04 heating season, 2008 is the 200-08 heating season, and 2009 is the 2008-09 heating season.

Figure 6.3: Median Heat Burden of SNAP (LIHEAP+LIRAP) Households by Zip Code in Heating Seasons 2004, 2008, and 2009



Note: 2004 is the 2003-04 heating season, 2008 is the 200-08 heating season, and 2009 is the 2008-09 heating season.

7. Measuring Heating Expenditure Shares for All of Spokane County

The goal of this section is to use cost data from Spokane County's electric and natural gas utilities to arrive at a measure of heating expenditure shares for the entire population dwelling in private residences. While billing data, stripped of all identifiers, were obtained for households, it was impossible to match income levels to these records. As a consequence, all analysis was carried out by census tract. The results, therefore, of this section represent census tract averages. Inferring beyond the averages, say to individual households, is highly problematic. For the purposes of this section, heating expenditures shares are calculated as the total *average* residential energy expenditures for space heating over the 2007-08 heating season as a percentage of the average of 2007 and 2008 median household incomes.

7.1 Methodology & Data

The analysis generally proceeds by first calculating total expenditures on energy for heating purposes, or a *heating surcharge,* for every census tract. The label surcharge is adopted to indicate household energy used for space heating only, over all other uses. The total is expressed as an average heating bill for all households in the census tract. That result is then placed over the tract's median household income to arrive at a ratio that expresses what the typical household in that census tract might spend on heat as a share of its income.

7.1.1 Gas and Electric Heating Expenditure Estimations

Natural gas monthly billing information was provided by Avista Utilities at the census tract level. Avista shared the total number of natural gas customers and the total natural expenditures in each census tract. If a residence had natural gas service, it is assumed that the residence uses natural gas as its main heating fuel. Only natural gas used for heating purposes was included in the estimations.

To determine this subset of natural gas use required the identification of a "base month", a month where virtually no natural gas was used for heating. An examination of the average residential gas use led to the choice of June as the most likely month to have little energy use for heating. The sum of billing differentials for the months of October through May, versus the prior June, during the 2007-08 heating season then constituted the heating surcharge.

Residential electric monthly billing information was provided by three of the five utilities that serve the county: Avista, City of Cheney, and Inland Power and Light. The three gave this information either by census tract, Zip+4 Code, or street address. Billing information that was provided at the Zip+4 Code level and street address was sent to Bamberg-Handley Inc., a geocoding service that assigns the most likely census tract based on address information. The three utilities included in the analysis represented nearly 88 percent of the residential market share in heating season 2008.

To arrive at an estimate of the amount of electricity spent for heating purposes required the identification of a similar base month, a month where virtually no electricity is used for heating or air-conditioning purposes. After an examination of the average residential electric use for the three utilities, June was again found to be the month with the lowest average total energy use per residential customer, thus the most likely month to have little energy use for heating or cooling. The sum of June billing differentials for the months of October through May, versus June, during the 2007-08 heating season constituted the heating surcharge for these electricity users.

The average surcharge for households heating with electric and gas for each census tract was then calculated by the following method:

- Multiply the number of households by the respective average household heating surcharge for every census tract to arrive at the total heating surcharge for the following:
    - Households with Avista gas service
    - Households with Avista electricity service but no Avista gas service
    - Households with electricity service from utilities other than Avista.
- Sum the total heating surcharges calculated for these three types of residences
- Divide the total heating costs by the sum of these three types of residences

The heating expenditures of those households served by utilities that could not provide census tract-level data were approximated by the average costs of Inland Power & Light residential customers. The number of these households was restricted to census tracts that lie in the zip codes served by these utilities. It should be noted that heating expenditures for households heating with oil or propane are not included in the estimates above but the number of households are. At this point, the calculated heating surcharges for census tracts are underestimated. The following steps attempt to estimate oil and liquid propane gas (LPG) heating use in each tract.

7.1.2 Fuel Oil and Liquid Propane Gas Heating Expenditure Estimations

No information on the number of oil and LPG users for the 2007-08 heating season was available. The research team consequently used results from the 2000 census and adopted the simplifying assumption that the numbers had not changed in the intervening years. As such, oil and LPG households were assumed to constitute 7.4% and 1.5%, respectively, of County households during the 2008 heating season.

Average heating cost for those residences had to be calculated, since the research team did not have access to customer billing data from the County's providers of these fuels. However, an estimate could be made from national data. According to the U.S. Energy Information Administration (EIA), residences in the Western U.S. heating with oil or propane spent a total of $1,592 and $2,048, respectively, during the period of October 1, 2007 through March 31, 2008; households in the West heating with natural gas spent an average of $591 during the same period. Table 7.1 takes up a complete profile of historical seasonal expenditures by heating fuel and region.

Table 7.1 Average Residential Heating Costs by Fuel Type

Average Expenditures for Heating Fuels					
	Winter of				
Region/Fuel	**03-04**	**04-05**	**05-06**	**06-07**	**07-08**
West			*$*		
Natural Gas	431	506	644	562	591
Heating Oil	632	882	1,091	1,134	1,592
Propane	1,100	1,308	1,532	1,609	2,048
Electricity	707	726	761	808	849
U.S. Average					
Natural Gas	651	729	934	807	850
Heating Oil	1,006	1,337	1,590	1,628	2,197
Propane	1,102	1,275	1,482	1,560	1,947
Electricity	704	722	787	830	863

Our cost estimates assumed that the EIA Western 07-08 cost ratios of oil and propane to natural gas applied equally to each census tract in the County. Specifically, oil and propane were calculated to be 2.7 and 3.5 times the cost, respectively, of natural gas. Average household natural gas heating expenditures determined for each census tract were then multiplied by these ratios to estimate the costs of households heating with oil and LPG over the 2008 heating season. These calculated average costs were, in turn, multiplied by the presumed number of households heating with each of the two fuels to arrive at total heating expenditures for the two fuels in each census tract.

7.1.3. Overall Heating Cost Estimation and Heating Burden by Census Tract

The following puts the above steps together.

1) Subtract the total number of households heating with oil or propane from the calculated number of households heating with electricity for each census tract. The balance is the estimated total number of households that heat with electricity.

2) Weight the average heating costs for each fuel by the respective number of households in each census estimated to use the fuel for:
   - Natural Gas
   - Electricity
   - Oil
   - Propane

3) The result is the total heating surcharge for that census tract.

4) Divide this result by the number of households in each tract to arrive at the Average Heating Surcharge. More formally, the calculation for the Average Heating Surcharge (SC) for any census tract j is calculated as:

$$SC_i = (N_{gas}SC_{gas} + N_{oil}SC_{oil} + N_{LPG}SC_{LPG} + N_{AvElectric}SC_{AvistaElectnogas} + N_{REA}SC_{REA}) / \sum N_i$$

Where:
N_i = Total number of households within the census tract using fuel i;
SC_i = The average surcharge within the census tract for fuel i.

Where the fuel subscripts are:

gas	refers to Avista natural gas households
oil	refers to fuel oil households
LPG	refers to liquid propane gas households
AvElectric	refers to households using Avista electricity but no natural gas
REA	refers to households using electricity from non-Avista utilities

5) To calculate the average heating share of the tract, divide overall average census tract heating cost for all fuel types combined by the average of median household incomes in 2007 and 2008 for each census tract.

We note that the number of households using non-Avista electricity was adjusted downward by the number of households using wood as a heating source. While the number of wood users has likely retreated since the most recent count (census 2000), its size, at approximately 5,000, was too big to ignore. As with the fuel oil and LPG estimates, the 2000 number served for the 2008 heating season estimate.

7.2 Results

Appendix B contains the results, tract by tract. Table 7.2 below summarizes the results by ranges of average heating shares.[xviii] The heating share values largely correspond to the "group" mean measures displayed in Table 3.2. Note that the number of households has been reduced by approximately 5,000 from the OFM estimates for 2007 and 2008, since wood-

Table 7.2 A Summary of the Frequency Heating Shares in All Census Tracts in Spokane County, For Heating Season 2008

Average Heating Share	Number of Census Tracts	Number of Occupied Housing Units	Share of Total Households
> 4.0%	1	1,630	0.9%
3.0% > 4.0%	1	1,040	0.6%
2.0% > 3.0%	9	16,017	9.3%
1.0% > 2.0%	71	111,684	64.7%
< 1.0%	24	41,995	24.4%
Totals	**106**	**172,366**	**100.0%**

burning households are outside the purview of our measurement. It is clear that the vast majority of census tracts produce an average heating share between 1 and 2 percent. In fact, the weighted average over all census tracts is 1.4%. Compare this to the result reported in Table 3.2 for the entire U.S. for all households for this measure: 1.1%. The difference is undoubtedly due to lower incomes in the County versus the national average. It is likely also due to the use of a median instead of a mean in the denominator of the ratio.

Note that 11 census tracts show an average heating share greater than 2 percent, but only two show shares higher than 3 percent. These results do not imply that everyone within a census tract faces the average depicted in Table 7.2 and Appendix B. There is undoubtedly a distribution of income in these tracts that puts some households under these share levels. However, those tracts with relatively high average heating shares likely have a high number of households clustered around the mean. Section 5 showed that poverty is clustered in certain zip codes in the County.

As Appendix B reveals, a large range of results stands behind the groupings in Table 7.2. The lowest heating share was 0.49% while the highest was 4.13%.

Maps provide an intuitive way to express this range among the census tracts. We thank Avista for their contribution of GIS software to provide the following maps. They are presented in pairs. The first pair shows our calculation of 2008 heating costs by census tracts for the County and of the City of Spokane. The second pair shows estimated median household income by census tract for the County and then the City of Spokane. The final pair shows the calculated heating shares for the County and the City of Spokane.

The heating shares, shown in Figure 7.1 and 7.2, do not reveal a strong pattern by census tract. Over all census tracts, the estimated heating expenditure average was $639. Average expenditures for residential heating tended to increase somewhat as one moves toward the City of Spokane core. However, the highest average residential heating costs are not there but located on the South Hill, Five-mile, and Dishman-Mica areas. Average expenditures by households for heating ranged from $682 to $1,154 for these census tracts for the 2008 heating season.

The lowest heating expenditures were estimated to be in the western census tracts of the City of Spokane and in central north part of Spokane County. These areas may have a larger percentage of residences that supplement their heating with wood, or the dwellings might be smaller. In the county overall, 88 percent of residents used electricity or gas as their primary heating source according to the 2000 census. Expenditures for the heating season ranged from $415-$478 for these areas. The Cities of Spokane and Spokane Valley had census tracts within their boundaries showing heating costs in this low range as well. This might be due to a higher percentage of residents who were apartment dwellers.

Figure 7.1

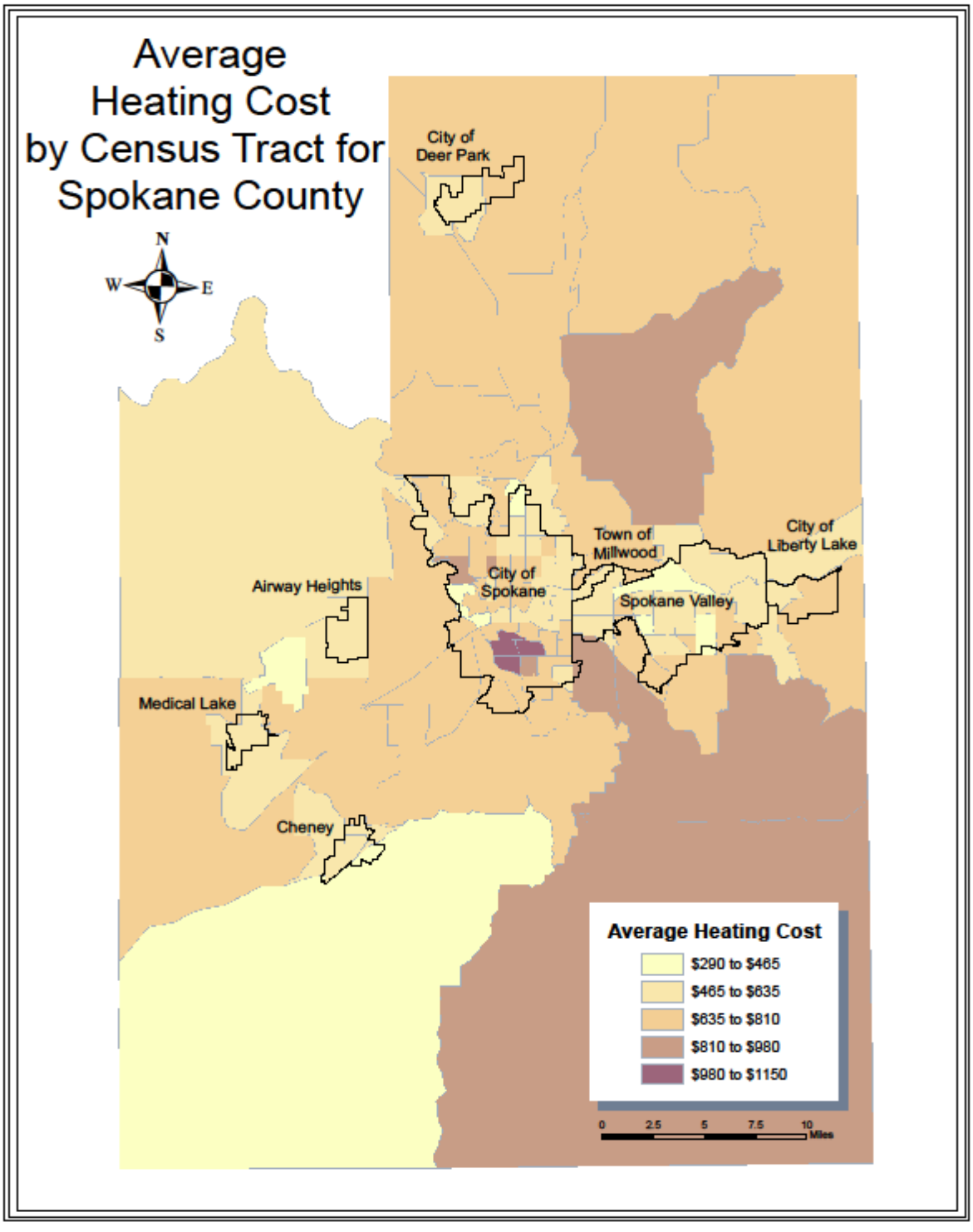
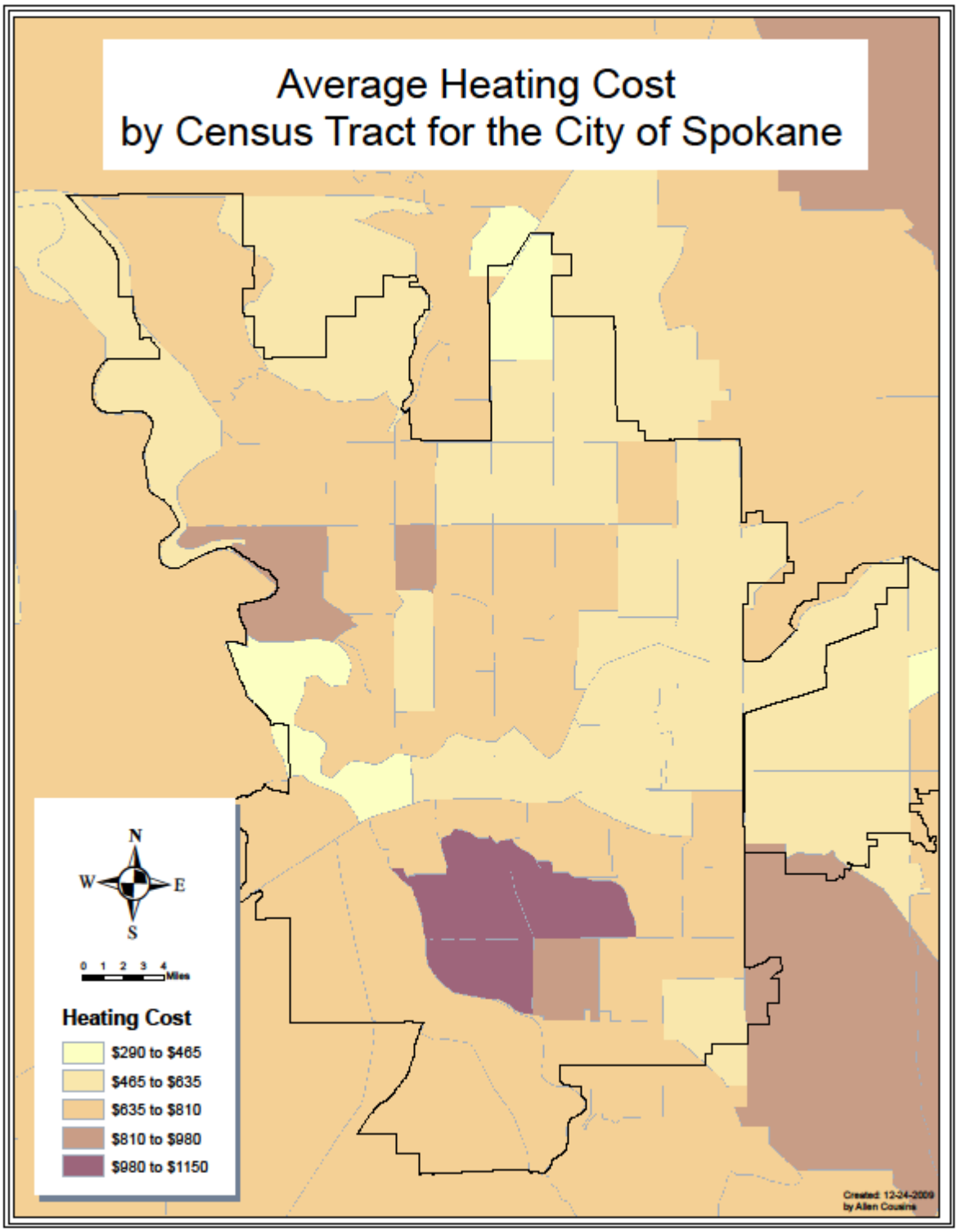

Average Heating Cost by Census Tract for Spokane County
N
W
E
S
City of Deer Park
Airway Heights
Medical Lake
Cheney
City of Spokane
Town of Millwood
Spokane Valley
City of Liberty Lake
Average Heating Cost
$290 to $465
$465 to $635
$635 to $810
$810 to $980
$980 to $1150
0
2.5
5
7.5
10
Miles

Figure 7.2


Average Heating Cost
by Census Tract for the City of Spokane
N
W
E
S
0 1 2 3 4
Miles
Heating Cost
$290 to $465
$465 to $635
$635 to $810
$810 to $980
$980 to $1150
Created: 12-24-2009
by Allen Cousins

An examination of comparative income information by census tract does point to a definite pattern. Median household incomes range from $69,387-$94,296 for households in census tracts located on the upper South Hill, Dishman-Mica, Five-Mile, Mead, Colbert, and Liberty Lake areas. They decrease as the proximity to the City Core increases. In the city core, estimated 2008 median incomes for households ranged from $12,066 to $26,505. In the surrounding rural areas, median household incomes fell in the $26,506-$69,386 range, with households in the municipalities of Deer Park, Cheney, Medical Lake, and Airway Heights showing incomes toward the lower end of the range.

The reported low incomes of Cheney and some Spokane core census tracts may be due to the presence of universities. Students are counted as households by the U.S. Census and Washington's Office of Financial Management.

Figure 7.3

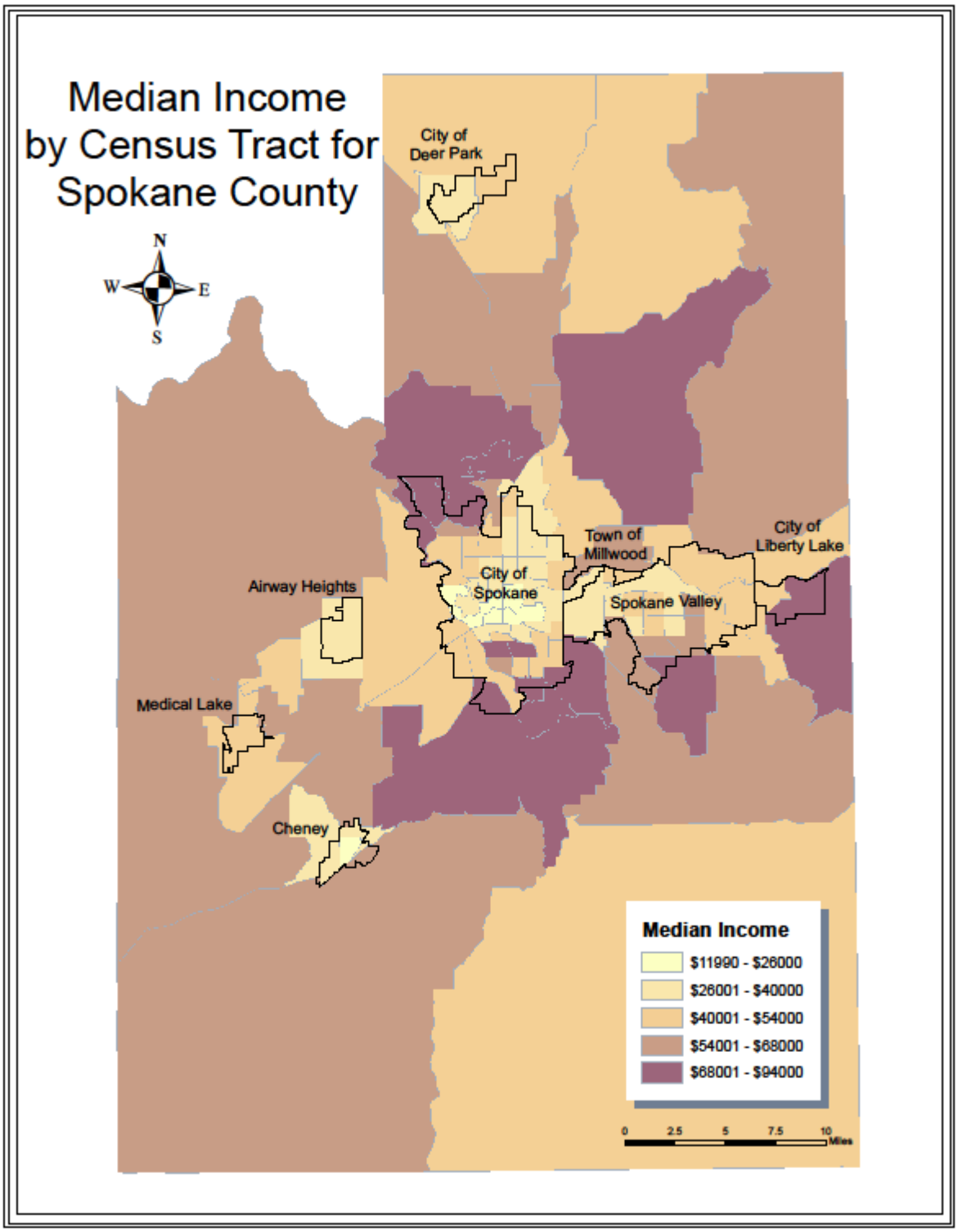
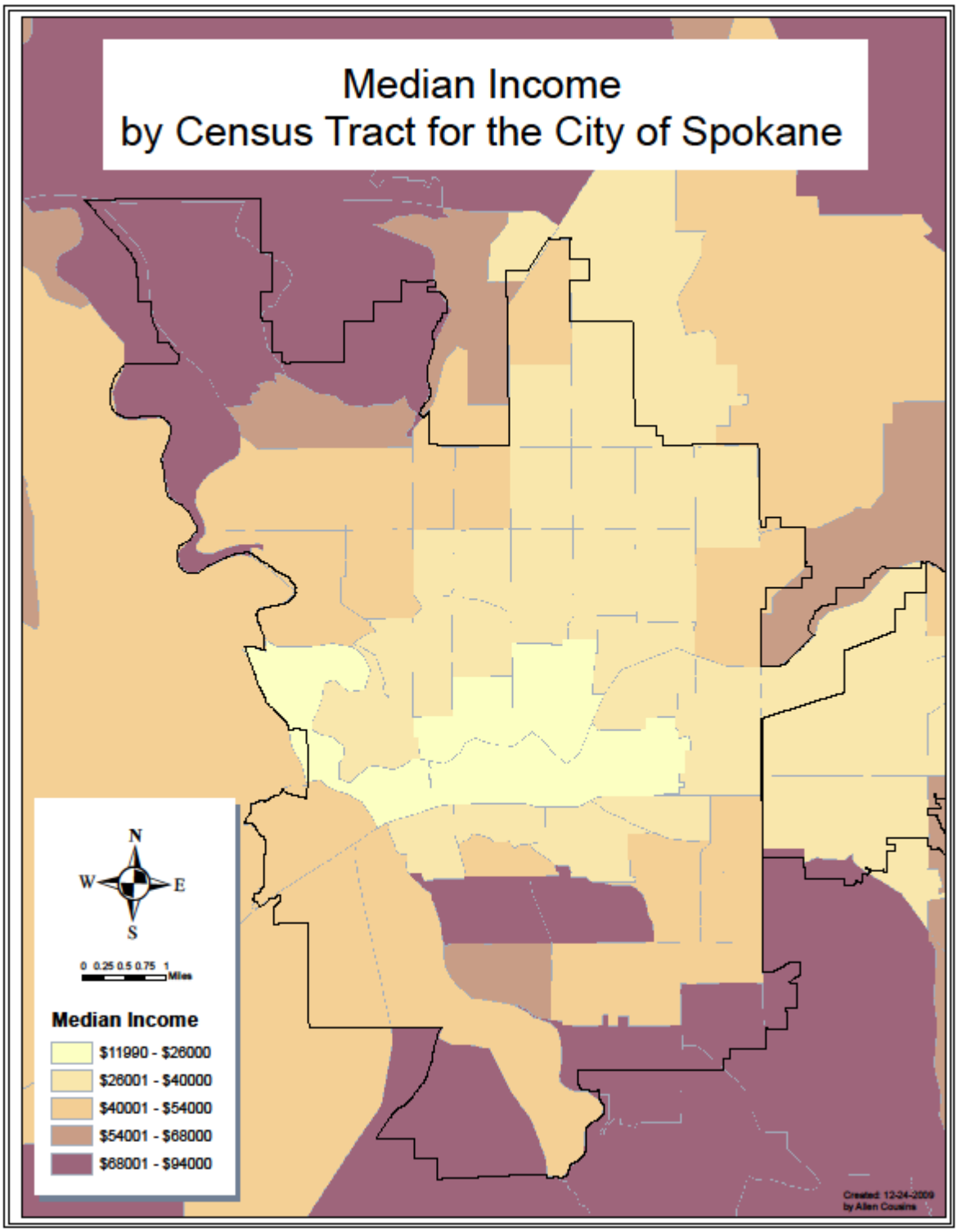

Median Income by Census Tract for Spokane County
N
W
E
S
City of Deer Park
Airway Heights
Medical Lake
Cheney
City of Spokane
Town of Millwood
Spokane Valley
City of Liberty Lake
Median Income
$11990 - $26000
$26001 - $40000
$40001 - $54000
$54001 - $68000
$68001 - $94000
0
2.5
5
7.5
10
Miles

Figure 7.4

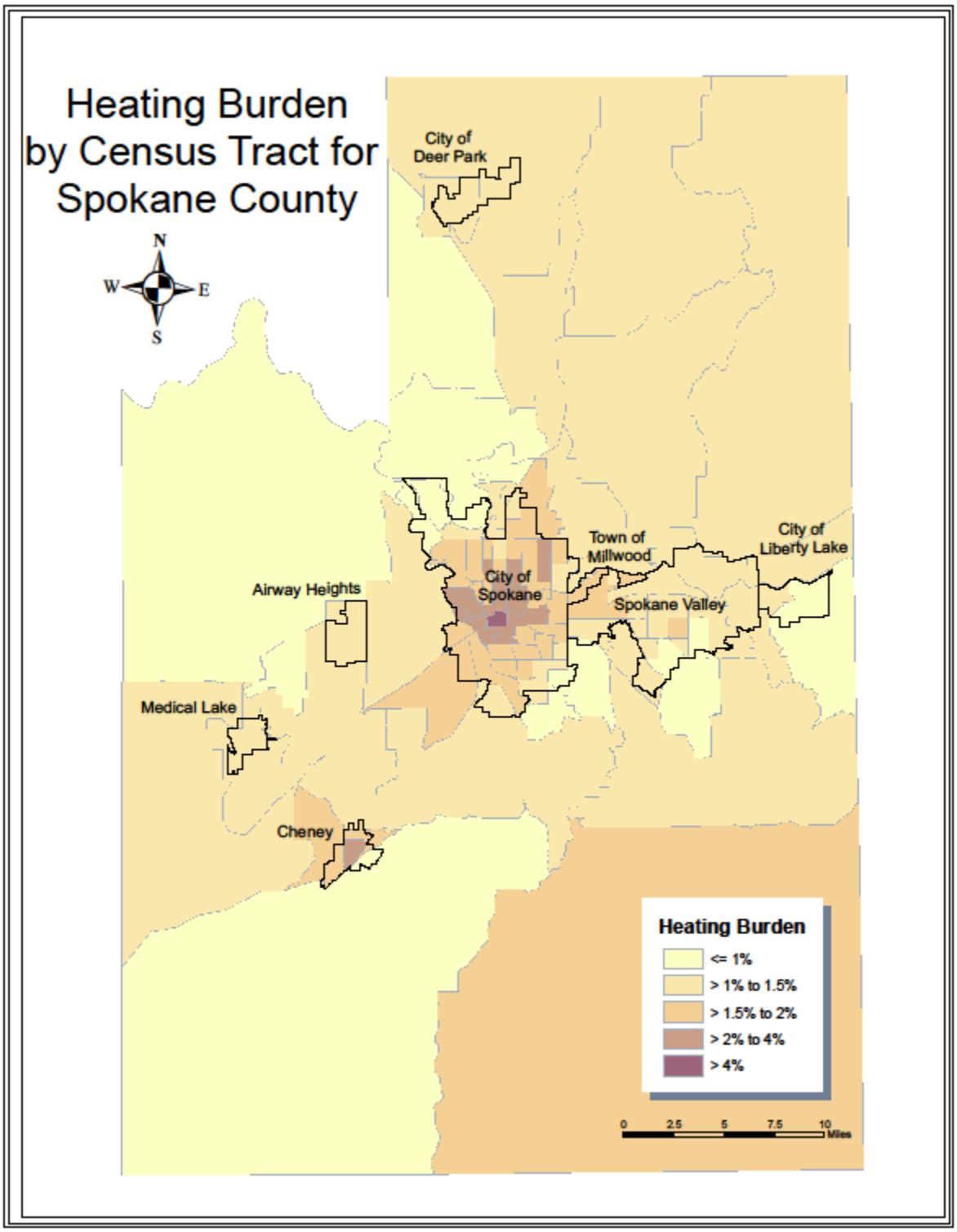

Median Income
by Census Tract for the City of Spokane
N
W
E
S
0 0.25 0.5 0.75 1
Miles
Median Income
$11990 - $26000
$26001 - $40000
$40001 - $54000
$54001 - $68000
$68001 - $94000
Created: 12-24-2009
by Allen Cousins

The display of estimated 2008 heating expenditure shares by census tract, shown below in Figure 7.5 and 7.6, also yielded a pronounced pattern. As the proximity to the Spokane City core increases, so does the share of heat in a household's budget. The highest heating share was, as noted, 4.13%, and is located in the inner Spokane City core. Six adjacent census tracts showed shares in the 2-4 percent range. Northeast Spokane City also revealed some high heating shares.

As one moves out into the suburbs, heating burdens decreased to 1.5% to less than one percent. This pattern is exhibited by the City of Spokane Valley as well, although it is not as distinct. Two census tracts in the City of Spokane Valley's "inner-city" showed burdens of 1.5 to 2 percent, again; however, most fell in the range of 1-1.5%.

One Cheney census tract and the large swath of the southern County south are the exceptions to the pattern of lower heating shares, as one moves from the center of the City of Spokane. However, the quintile ranking (3rd lowest) of the households in the southern county matches its ranking by household income. The one Cheney census tract with the 2nd (lowest) quintile ranking in heating shares also matches its income ranking. In general, the pattern of median household income shows a highly (negatively) correlated relationship with the pattern of heating expenditure shares. This underscores the findings of section 5, where household income levels are seen as a proxy for heating burden.

Figure 7.5


Heating Burden by Census Tract for Spokane County
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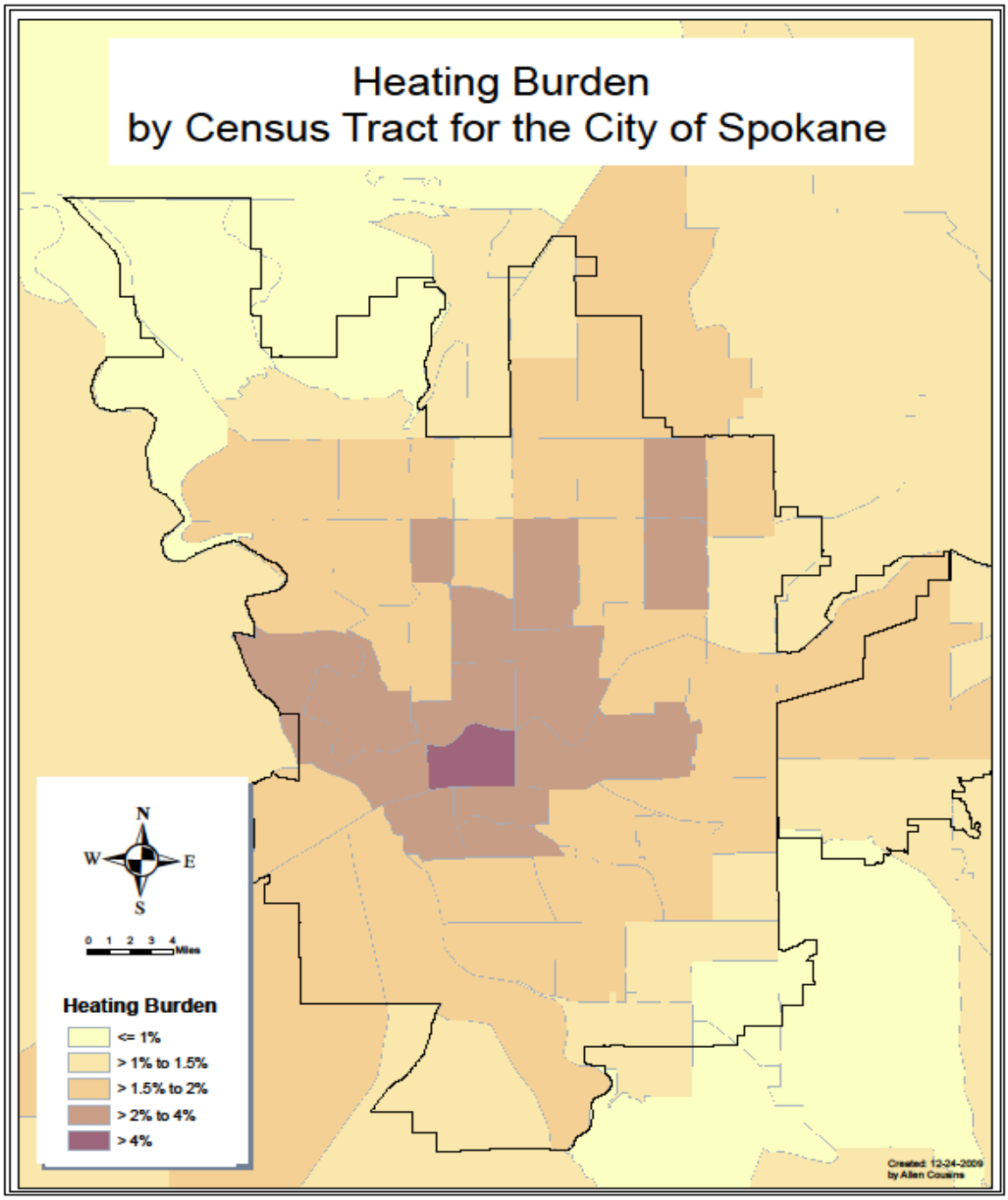
E
S
City of Deer Park
Town of Millwood
City of Liberty Lake
City of Spokane
Spokane Valley
Airway Heights
Medical Lake
Cheney
Heating Burden
<= 1%
> 1% to 1.5%
> 1.5% to 2%
> 2% to 4%
> 4%
0 2.5 5 7.5 10
Miles

Figure 7.6


Heating Burden
by Census Tract for the City of Spokane
N
W
E
S
0 1 2 3 4
Miles
Heating Burden
<= 1%
> 1% to 1.5%
> 1.5% to 2%
> 2% to 4%
> 4%
Created: 12-24-2009
by Allen Cousins

8. Caveats, Qualifications & Conclusions

The essential methodological challenges to this study lay in the research team's inability to access individual records that contain both heating cost and income data. In the absence of this source information, errors of data accuracy have certainly been introduced. The creation of separate data sets for household income levels and heating costs involved a set of unavoidable assumptions that all contributed some error to the final results. To estimate household income, the team worked with income brackets and not a full distribution of actual household incomes. It had to assume that distribution of income within a census tract did not change over the near decade under consideration. With no specific information about household size by income brackets, it applied an average across all brackets.

For the estimate of at-risk households with at least one senior member, the procedure assumed that the share of a census tract's senior population was the same in 2008 as in 2000. For the estimation of the number of at-risk households over the 2009-2012 period, the techniques employed assumed that future household population growth will follow the rate of the prior 10 years, that the share of at-risk households to total households will remain constant, or that the relationship between 1999 median household income and the share of at-risk households throughout Washington State will hold in the future for Spokane County. All these assumptions are subject to change.

The creation of a heating cost data set for the heating season 2008 for all Spokane County residences faced many challenges. These led to the use of several simplifying assumptions. First, not all electric utilities contributed data to the project. Consequently, costs for the omitted households had to be proxied by costs from an appropriate utility. Second, the research team was skeptical of the accuracy of the translation of electric utility zipcode data into census tracts for certain certain tracts. Third, records for actual fuel oil and liquid propane heating costs were completely absent. While the latter fuel plays a minor role throughout the County, fuel oil use is quite high in many, Spokane City census tracts. The costs to County households had to be inferred from national Department of Energy data, and not gathered from the purveyors, as was the case in natural gas and electricity.

Third and most importantly, with the exception of Avista natural gas customers, utility cost data that the research team received covered a mix of households that heated with electricity, fuel oil, liquid propane, and for non-Avista electric utility customers, Avista gas. To arrive at a mutually (fuel) exclusive set of users, the research team had to use detailed census tract data from 2000 and thereby assumed that the number of fuel oil and propane users in 2007/2008 was the same.

Finally, it bears noting that the resulting heating share or burden ratio is a hybrid of the group approach discussed in section 3.3. Its numerator is a mean, or average, while its denominator is a median. The measures from the national survey data reported in Table 3.2 used a ratio of two means. We did not have the capability to calculate median heating costs by census tract. Census tract household income, as estimated by the Washington State Office of Financial Management, is published only as a median. If one assumes a certain homogeneity within census tracts, the difference between mean and median income, by tract, may not be great. Normally however, mean income is higher than median income. If that relationship holds even slightly within the census tracts of Spokane, then the resulting mean heating shares or burdens contain an unknown amount of upward bias.

Despite these reservations, the research team notes the relatively high comparability between our results and those from the latest national survey (RECS). The differences between the two studies likely rest in the the greater pervasiveness of poverty in Spokane County than in local data deficits. In sum, the techniques employed in this study can be replicated for those service areas in which annual census tract estimates of popuation are available and in which the natural gas and electric utilities can provide billing data with some geocoding.

References

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Appendix A: Key to City and Town Abbreviations in Figures 5.2 and 6.2

AIRW = Airway Heights
CHAT = Chattaroy
CHEY = Cheney
CLAY = Clayton
COLB = Colbert
DEER = Deer Park
EDW = Edwall
ELK = Elk
FAIR = Fairfield
FORD = Ford
GRNA = Green Acres
LIBLK = Liberty Lake
MEAD = Mead
MICA = Mica
MILL = Millwood
MEDLK = Medical Lake
MRSH = Marshall
MTSPK = Mt. Spokane
NEWLK = Newman Lake
NEWP = Newport
NINE = Nine Mile Falls (Stevens County but associated zip code includes Washington)
OPPO = Opportunity
OTIS = Otis Orchards
REAR = Reardan (Lincoln County but associated zip code includes Washington)
ROSA = Rosalia (Whitman County but associated zip code includes Washington)
ROCK = Rockford
SPGL = Spangle
SPK = City of Spokane
SPV = City of Spokane Valley
TRNW = Trentwood
VERD = Veradale
VFORD = Valley Ford

Appendix B: Table of Heating Shares for Spokane County Census Tracts in Heating Season 2008

Census Tract	Number of Occupied Housing Units	Estimated Household Income	Average Heating Cost	Heating Share of Median Household Income
1	322	$32,384	$562.25	**1.74%**
2	1,762	$33,127	$682.66	**2.06%**
3	2,001	$36,999	$600.92	**1.62%**
4	1,672	$29,757	$561.98	**1.89%**
5	1,408	$44,214	$638.44	**1.44%**
6	1,175	$44,056	$718.87	**1.63%**
7	2,059	$42,794	$667.44	**1.56%**
8	1,851	$64,282	$756.19	**1.18%**
9	2,349	$50,252	$772.12	**1.54%**
10	2,311	$43,630	$854.46	**1.96%**
11	1,386	$48,376	$800.16	**1.65%**
12	920	$38,310	$745.79	**1.95%**
13	1,479	$38,137	$633.96	**1.66%**
14	2,504	$32,782	$653.08	**1.99%**
15	2,012	$34,966	$633.19	**1.81%**
16	1,389	$26,338	$515.47	**1.96%**
17	1,439	$44,806	$626.19	**1.40%**
18	1,226	$34,404	$562.67	**1.64%**
19	1,491	$36,990	$740.80	**2.00%**
20	1,749	$35,843	$607.40	**1.69%**
21	978	$38,460	$659.31	**1.71%**
23	1,992	$29,393	$734.74	**2.50%**
24	1,029	$17,627	$652.65	**3.70%**
25	2,699	$24,693	$655.69	**2.66%**
26	1,915	$31,509	$479.39	**1.52%**
28	339	$30,440	$597.20	**1.96%**
29	1,191	$43,998	$692.20	**1.57%**
30	857	$34,882	$614.34	**1.76%**
31	1,951	$37,797	$655.37	**1.73%**
32	1,489	$26,211	$722.99	**2.76%**
33	661	$23,045	$547.83	**2.38%**
35	1,630	$11,990	$494.82	**4.13%**
36	2,349	$20,442	$409.09	**2.00%**
38	823	$43,515	$717.11	**1.65%**
39	945	$44,646	$736.02	**1.65%**
40	2,535	$30,725	$686.52	**2.23%**
41	1,040	$47,071	$977.00	**2.08%**
42	1,931	$68,950	$1,146.16	**1.66%**
43	1,382	$67,944	$1,034.20	**1.52%**
44	1,966	$45,637	$848.02	**1.86%**

Census Tract	Number of Occupied Housing Units	Estimated Median Household Income	Average Heating Cost	Heating Share of Median Household Income
45	1,428	$72,798	$1,143.16	**1.57%**
4601	1,854	$44,640	$789.34	**1.77%**
4602	1,113	$51,717	$664.09	**1.28%**
47	2,662	$47,670	$597.29	**1.25%**
48	1,507	$77,572	$588.53	**0.76%**
49	2,335	$72,930	$702.90	**0.96%**
50	1,162	$75,371	$629.85	**0.84%**
101	1,815	$67,641	$633.83	**0.94%**
10201	961	$47,748	$650.61	**1.36%**
10202	1,926	$77,907	$803.16	**1.03%**
10301	1,301	$39,251	$543.91	**1.39%**
10303	870	$65,490	$608.25	**0.93%**
10304	1,472	$48,666	$723.12	**1.49%**
10305	1,654	$66,264	$778.64	**1.18%**
10401	1,152	$36,399	$479.61	**1.32%**
10402	2,022	$64,796	$620.12	**0.96%**
10501	2,619	$72,412	$632.62	**0.87%**
10503	2,085	$80,238	$774.85	**0.97%**
10504	1,261	$62,614	$629.13	**1.00%**
10601	1,325	$68,924	$605.32	**0.88%**
10602	2,434	$89,949	$667.25	**0.74%**
107	1,428	$88,216	$730.14	**0.83%**
108	920	$33,938	$444.88	**1.31%**
109	1,422	$56,580	$777.38	**1.37%**
110	1,333	$47,995	$692.05	**1.44%**
11101	2,408	$31,838	$534.47	**1.68%**
11102	1,336	$41,197	$408.35	**0.99%**
11201	2,933	$33,329	$481.64	**1.45%**
11202	1,437	$51,313	$654.90	**1.28%**
113	2,491	$62,940	$637.39	**1.01%**
114	1,945	$45,947	$574.97	**1.25%**
115	567	$47,278	$602.43	**1.27%**
116	734	$41,938	$643.08	**1.53%**
117	3,455	$35,582	$404.80	**1.14%**
118	2,316	$36,301	$387.69	**1.07%**
119	1,669	$41,707	$432.97	**1.04%**
120	1,623	$41,571	$523.34	**1.26%**
121	1,061	$34,559	$636.70	**1.84%**
122	963	$38,120	$580.89	**1.52%**
123	2,376	$35,141	$496.07	**1.41%**
12401	1,629	$65,933	$643.50	**0.98%**
12402	1,949	$84,522	$647.59	**0.77%**

	Estimated			
Census Tract	Number of Occupied Housing Units	Median Household Income	Average Heating Cost	Heating Share
125	1,323	$34,809	$452.19	**1.30%**
126	1,467	$45,468	$551.07	**1.21%**
12701	1,514	$39,060	$526.07	**1.35%**
12702	788	$56,183	$647.38	**1.15%**
12801	1,563	$58,273	$523.18	**0.90%**
12802	1,281	$61,513	$600.91	**0.98%**
12901	1,043	$54,080	$507.85	**0.94%**
12902	2,487	$58,215	$393.86	**0.68%**
130	2,499	$50,115	$484.53	**0.97%**
131	3,239	$46,967	$592.68	**1.26%**
13201	2,464	$52,039	$617.75	**1.19%**
13202	2,824	$73,784	$695.64	**0.94%**
133	813	$64,709	$868.09	**1.34%**
13401	1,557	$93,704	$857.36	**0.91%**
135	2,245	$73,993	$732.40	**0.99%**
136	1,293	$44,971	$674.97	**1.50%**
137	917	$46,423	$656.63	**1.41%**
138	1,043	$40,660	$333.52	**0.82%**
139	1,839	$52,750	$546.53	**1.04%**
14001	1,942	$23,427	$404.06	**1.72%**
14002	1,575	$37,175	$442.88	**1.19%**
141	1,508	$55,747	$652.35	**1.17%**
142	937	$60,258	$292.73	**0.49%**
143	1,035	$47,536	$873.63	**1.84%**

Endnotes

[1] The Human Services Amendments of 1994, Public Law 103-252, Sec. 2602(a), as amended, reported in the *LIHEAP Home Energy Notebook for Fiscal Year 2006,* U.S. Department of Health & Human Services, Administration for Children and Families, Office of Community Services, Division of Energy Assistance, August, 2008.

[2] From http://www.liheapwa.org/Page.aspx?nid=5, downloaded December 15, 2009.

[3] Sources: Census, Population Finder: http://factfinder.census.gov/servlet/SAFFPopulation?_submenuId=population_0; Washington State Office of Financial Management: http://www.ofm.wa.gov/pop/april1/default.asp; and Spokane Community Indicators: www.communityindicators.ewu.edu; all downloaded 12.14.2009.

[4] Avista Utilities, *Sixth Annual Report (May 2006-April 2007), submitted to the Washington State Utilities and Transportation Commission, August 29, 2007.*

[5] The Western Census region includes the Rocky Mountain and Pacific states, as well as Alaska and Hawaii, for a total of 13.

[6] Standard deviation is a measure of the dispersion of a distribution of numbers, or, how far the values fall from the mean. Formally, it is the square root of the variance of a distribution. For data that are highly concentrated around the mean, the standard deviation will be low; for a widely dispersed distribution, the standard deviation will be high.

[7] From the U.S. Census: "Census tracts are small, relatively permanent statistical subdivisions of a county. Census tract boundaries normally follow visible features, but may follow governmental unit boundaries and other non-visible features in some instances; they always nest within counties. Designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions, census tracts average about 4,000 inhabitants.

[8] See the "Conclusions" of the Executive Summary.

[9] This approach assumes that the share of the 65+ population group in any year since 2000 has been relatively constant. While the share has edged up over time, the movement has been slight.

[10] For example, assume we have a total of 16 income brackets per census tract at time t: $[B_{L,1,t}, B_{U,1,t}]$, $[B_{L,2,t}, B_{U,2,t}]$, $[B_{L,3,t}, B_{U,3,t}]$, and so on until $[B_{L,16,t}, B_{U,16,t}]$. If the adjusted poverty line fell in bracket three, then the ARH would be the sum tract households in brackets one, two, and three.

[11] *2005 LIHEAP Energy Burden Evaluation Study*.

[12] Spokane Community Indicators, www.communityindicators.ewu.edu/graph.cfm?id=97

[13] Because some tracts cover a large area, the cities/towns attached to each tract reflect the principle population centers in or on the border that tract.

[14] SNAP's distribution of funds starts in the fourth quarter each year and extends into the first quarter of the New Year. That is, strictly speaking, 2004 reflects the winter months of 2003-04, 2005 reflects the winter months of 2004-05, and so on.

[xv] The average was used since real annual HHI did not have a clear trend over the 1999-2007 period. OFM nominal income estimates for Spokane County were used to calculate this average, after they were deflated using the Western CPI for b/c cities. The index was rescaled to so that the CPI was 100 in 1999.

[16] See LIHEAP Energy Burden Evaluation Study (Final Report, July 2005), pp. 11-12. This provides a detailed description of the methodology for calculating the thresholds for high and moderate heating/cooling burdens.

[17] The city/town attached with each zip code reflects the address location provided in the SNAP database.