

**DETERMINING HOUSEHOLD ENERGY CONSUMPTION
IN WASHINGTON STATE
IN THE ABSENCE OF 12 MONTHS OF USAGE DATA**

By:

**Roger D. Colton
Fisher, Sheehan and Colton
Public Finance and General Economics
34 Warwick Road
Belmont, MA 02478
617-484-0597 *** 617-484-0594 (fax)**

Washington State must determine how best to estimate low-income heating bills when a full year of data is not available at the service address for which assistance is sought. Under CTED's proposed formula to distribute LIHEAP, along with Evergreen Legal Services Corporation's (LSC) proposed modifications thereto, the actual energy bill is used as the starting point for analysis. Less than a full twelve months of actual billing can be accepted so long as at least nine months of data is available. At that point, however, CTED says that a surrogate for the household's usage must be found. The issue before us is what that surrogate should be.

The problems posed by low-income mobility are prevalent throughout the country. While data specific to Washington State is not available, national data shows that of the households who have moved within the last twelve months,¹¹ a disproportionate share are low-income. As Table 1 shows, depending on household size, from one-quarter to three-quarters of the population who moved within the past twelve months had incomes of at or below \$15,000.¹² More than one-third (36 percent) of the total population of recent movers had incomes in the range of \$0 to \$15,000.

To seek to determine how to develop a surrogate heating bill for households with less than twelve months of residence at their current address,

¹¹ The most recent national data is from 1989.

¹² This, of course, underestimates the total low-income population, since an annual income of \$15,000 is substantially below 150 percent of the federal Poverty Level for larger households. Nonetheless, LIHEAP data reported in the HHS annual LIHEAP report to Congress indicates that an extremely small proportion of LIHEAP recipients have incomes of more than \$15,000, irrespective of household size. Hence, the \$15,000 breakpoint was deemed reasonable for purposes here.

FSC studied the national data involving a population with three characteristics: (1) they were recent movers, (2) who had annual incomes of at or below \$15,000, and (3) who used natural gas as their primary space heating source. Based on this data, we conclude that the best surrogate for annual heating bills for these households is the energy bill for the household who lived in the same unit during the immediately preceding twelve month period.

CONCEPTUAL OVERVIEW

The theory behind endorsing use of the previous twelve months of data for the dwelling unit as the best surrogate for consumption relies initially on the observation that heating consumption, in contrast, to appliances and hot water consumption, is more a function of the dwelling unit than of the particular individuals who live in the unit. The heating consumption, in other words, is driven by the size of the unit, the condition of the unit, the weatherization characteristics of the unit, the heating degree days to which the unit is exposed, and the like, more than household characteristics such as the level of heat maintained by the household, the amount of time the household is at home, and the like.¹³¹ This is obviously not to say that household or individual characteristics do not play a role in determining heating consumption, merely a smaller role.

This conclusion is bolstered by the model developed to calculate heating consumption in FSC's *Assessment of Low-Income Energy Needs in Washington State*. That study, relying upon data from the U.S. Department of Energy's *Residential Energy Consumption Survey*, calculated low-income heating consumption using the model:

$$-45.299 + .003(\text{HDD}) - 8.703(\text{LOW}) - 1.756(\text{PRICE}) + 51.986(\text{SQFT}) + .001(\text{HHINC})$$

WHERE: HDD=Heating Degree Days; Low=low-income indicator; PRICE=price of fuel; SQFT=square feet of housing in thousands of square feet; and HHINC=household income.

In this model, the major factors affecting heating consumption include heating degree days and the square feet of the housing. Both are factors specific to a unit and not to the household living in the unit. A substantially smaller impact on total heating consumption is created by price and household income, factors specific to individual households.¹⁴¹

¹³¹ There is no need to determine which factors drive electric usage, or hot water usage, since LIHEAP is designed only to pay for heating bills.

¹⁴¹ Price is important due to the price elasticity of demand, a household characteristic.

THE NATIONAL DATA

National data shows that similarly sized households tend to live in similarly sized housing units. As a result of this observation, we can conclude that if one low-income household moves out of a unit of a certain size, a household of a similar size will move back into that unit. Moreover, if a household of a particular size moves out of a unit, it will move back into a unit of a similar size. Let us examine the data in support of those propositions.

As the data in Table 2 show, within the low-income population, the number of bedrooms in the home will likely limit the size of households moving into that home. Just as few one-person households move into a three bedroom home, in other words, few five person households move into one bedroom homes.

The column data is even more impressive than the row data in this regard. With the exception of two bedroom units, the size of a unit provides an important element in predicting the size of the household that will move into the unit within the low-income community.¹⁵¹

It is true that the data shows the predictive value is not perfect. One person households are evenly split between one and two bedroom homes; four person households are evenly split between two and three bedroom homes; five person households, too, are evenly split between two and three bedroom homes. Nonetheless, the data does provide some confidence that there will not be a sharp divergence in household size in units occupied by recent movers. Odds are high that a particular unit that was vacated by a one person household will not have a five person household move in.

In examining this mobility data, FSC engaged in the assumption that housing occupied by low-income households will *remain* occupied by low-income households if the occupant moves. While we do not have data to support this assumption, the assumption *is* supported by long years of experience in designing energy efficiency and fuel assistance programs.

FACTORS AFFECTING CONSUMPTION

¹⁵¹ As to two bedroom units, further inquiry would be merited as to whether the predictive ability would increase if the size of the unit is controlled for unit type (*e.g.*, single family, four-plex, high rise, mobile home).

It is impossible, of course, to identify *all* of the factors that will affect the heating consumption of a particular household at a particular dwelling unit. The physical condition of the structure, the age and condition of the heating system, the daytime and nighttime temperatures maintained in the home, the weatherization characteristics of the home, and the lifestyle of the occupants, all have an impact. It would seem to be difficult, if not impossible, to create a model sufficiently detailed to accurately predict *individual* household usage to operate with any degree of administrative feasibility within the confines of a LIHEAP program. At the least, by relying upon past consumption from the same dwelling unit, most of the major influencing factors are held constant.

This conclusion is subject to some empirical verification. Consider a variety of factors that might affect heating consumption:

- o Unit size
- o Heating degree days
- o Age of dwelling unit
- o Age of heating unit
- o Household size
- o Age of household head
- o Type of unit
- o Daytime/nighttime temperature
- o Household income

Table 3 below presents data on the influence of various factors. The Table sets forth national average natural gas heating consumption for households at or below 100 percent of the federal Poverty Level. The Table then presents the maximum usage for households at or below the federal Poverty Level given variations in each of these individual factors and the range within which that factor gives rise to the maximum. In an effort to assess the significance of each factor on driving usage up,¹⁶⁾ the percent which the maximum for each factor deviates from the average is noted. Finally, the Table considers whether the factor is held constant by using the dwelling unit consumption for the immediately preceding twelve months as a surrogate for actual usage, when actual usage data is not available. Cumulative impacts are not considered. Nor are factors which might simply mirror other factors considered.¹⁷⁾

¹⁶⁾ We look at the *maximum* usage since it is high consumption about which there is the most concern. If consumption (and thus bills) are underestimated, the household will receive too few benefits and be placed in jeopardy due to an inability to pay during the winter heating season.

¹⁷⁾ For example, the size of a home and urban/rural status may be related.

As can be seen from this data, the factors that have the greatest potential to result in natural gas space heating consumption different than the average are the factors which remain constant if CTED looks at the heating consumption for the same dwelling unit during a previous time period.¹⁸¹

SUMMARY AND CONCLUSIONS

FSC recommends that the surrogate to be used for households who lack data to establish actual home heating bills for their current dwelling unit involve consumption data for the same unit from previous occupants in a preceding time period. National data indicates this would be an appropriate surrogate. At the least, CTED should adopt this rule as an interim rule pending completion of the additional inquiry proposed below.

It should be possible to develop data specific to Washington State LIHEAP recipients in this regard. After deciding to rely upon previous usage of the dwelling unit for this year, CTED should undertake a review of the last several years of LIHEAP data. In those instances where LIHEAP benefits are provided to the same service address but to different recipients, CTED should determine whether the national data reported above holds for Washington State as well (*i.e.*, that if a household of a certain size moves *out* of a unit, it is likely that a household of the same size will move back in to that unit).

If this proves true, CTED should retain the mechanism of using the past consumption at the dwelling unit as the best predictor of actual consumption when actual usage data is not available.

Table 1
 Number and Percent of Households Having Moved within Last 12 Months
 By Household Size for Entire Country

HH Size	\$0-\$5000	\$5,001-\$10,000	\$10,001-\$15,000	\$15,000+	Total	Percent
1	573,285	823,669	607,390	2,338,673	4,343,017	46.2%
2	384,124	470,554	521,236	3,924,927	5,300,841	26.0%
3	295,405	349,096	303,007	2,193,029	3,140,537	30.2%
4	193,710	170,006	208,968	176,283	748,967	76.5%
5	76,786	85,224	148,794	810,095	1,120,899	27.7%
Totals	1,523,310	1,898,549	1,789,395	9,443,007	14,654,261	35.6%

Table 2
 Number of Households Distributed by
 Bedroom Size and Household Size
 for Households Moving within Past 12 Months

HH Size	No. of Bedrooms							Total
	0	1	2	3	4	5	>5	
1	29,491	385,196	319,487	45,895	11,023	0	0	791,092
2	7,870	174,699	314,277	88,925	9,975	0	0	595,746
3	9,968	77,578	360,861	178,422	21,159	4,192	1,652	653,832
4	5,487	30,122	211,704	206,167	22,849	6,612	0	482,941
5	0	11,447	131,312	120,669	53,940	2,211	2,159	321,738
Totals	52,816	679,042	1,337,641	640,078	118,946	13,015	3,811	2,845,349

Table 3
Factors Affecting Natural Gas Heating Consumption
for Households at or Below 100 Percent of Poverty

Factor	Avg Use (mmBtu)	Variance		Amt Max Exceeds Avg	Held Constant in Same Dwelling
		Factor w/ Max	Use (mmBtu)		
Type of unit	42.5	1-family	50.5	0.19	Y
Heated floorspace	42.5	2,000+	87.1	1.05	Y
Tenure	42.5	Owned	51.2	0.20	Y (by assumption)
Year of construction	42.5	1949 or before	49.7	0.17	Y
Family income (not considering >\$20,000)	42.5	\$10-\$19,999	36.1	-0.15	N
Age of householder	42.5	35-58	48.4	0.14	N
Household size	42.5	2-4 persons	44.6	0.05	Y (by assumption)
Main htg equipment	42.5	Steam/Hot water	83.7	0.97	Y
Age of main htg equip	42.5	10-18 yrs	47.9	0.13	Y
Winter temp inside house	42.5	Prefer warmer	42.9	0.01	N