sierra research

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2010 Fairbanks Home Heating Survey

prepared for:

Alaska Department of Environmental Conservation

June 21, 2010

prepared by:

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2010 FAIRBANKS HOME HEATING SURVEY

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1. SUMMARY

Under Contract No. 18-5022-10 funded by the Alaska Department of Environmental Conservation (ADEC), Sierra Research, Inc. (Sierra) conducted a telephone-based survey of residential home heating devices and practices within the Fairbanks $PM_{2.5}$ nonattainment area. Sierra coordinated the study and performed validation and analysis of the collected data. Sierra hired Hays Research Group (Hays) to randomly sample households by ZIP code within the nonattainment area, perform the telephone survey, and deliver the detailed, electronically recorded survey data results to Sierra. The telephone survey was conducted between January 22 and February 16, 2010. A total of 300 household responses were targeted. After review of the recorded data, a validated sample of 299 households remained.

Purpose – The primary purpose of this study was to collect up-to-date information on residential heating practices in Fairbanks during the winter season when extremely cold ambient temperatures cause a significant seasonal increase in fuel combustion for residential heating. Sierra and Hays had conducted similar ADEC-sponsored telephone-based home heating surveys in Fairbanks during the 2005-2006 and 2006-2007 winter seasons. The results of those earlier studies suggested that wood burning use had increased measurably since earlier in the decade, which was likely caused by the large run-up in home heating oil prices during that timeframe.[*]

ADEC funded this latest survey to ascertain whether this trend or level of wood use has continued and to gain information about other heating types and fuels, such as outdoor wood boilers and coal, that were not explicitly identified in the earlier 2006 and 2007 surveys for use in preparing updated emission inventories to support development of the $PM_{2.5}$ State Implementation Plan for Fairbanks.

Survey Content – The survey focused on identifying the types and usage practices of different home heating devices used in residences within the nonattainment area during winter months. It was organized into a hierarchical series of 71 separate questions that respondents were asked to answer based on the types of heating devices available and used within their homes. Key questions included listing the types of devices used in the household (including the specific type of wood-burning device if used), identifying whether multiple devices were used in the household, and estimating the amount of fuel used in each device (e.g., cords of wood or gallons of heating oil) both during winter and on an annual basis.

[*] Given the energy needed to heat homes in Fairbanks under extremely cold wintertime temperatures, home heating costs are substantial. Wood-burning devices offer a cheaper alternative to heating oil at current market prices.

The survey also included questions about future home heating practices, such as estimating the heating oil price that would trigger each respondent to stop burning wood and indicating whether respondents planned to change the devices currently being used for home heat some time within the next two years.

For the first time, the survey also asked respondents to estimate the moisture content of their wood and drying or seasoning periods (in months) before wood is burned. As described later in the report, the results of the moisture content estimates are of questionable value because of the small number of responses to that question and the difficultly for most residents to accurately estimate the moisture levels in their wood. (As discussed later in the report, a separate, concurrent study to this effort is being conducted to collect actual wood moisture measurements.)

Study Phases and Issues Encountered – The study consisted of three primary phases as listed and summarized below.

1. *Design* – The design phase included two key elements. First, a methodology based on U.S. Census data was applied to determine how many households to sample within each of the ZIP codes contained in the nonattainment area to produce a representative cross-section of heating practices that vary within the area (for example, to account for the fact that only portions of the area have access to steam-circulated District or "municipal" heat). Second, the survey structure and questionnaire used in the earlier home heating surveys were re-designed to incorporate several additional questions (e.g., wood moisture content) and ensure these additional questions were asked at logical points during the survey. Sierra and Hays collaborated on this phase.

2. *Survey* – The second phase of the study consisted of performing the actual telephone survey and recording the individual household responses to each question into a series of well-organized electronic data files. Hays performed this phase.

3. *Analysis* – The third and final phase of the effort consisted of first performing a detailed set of data consistency and range checks on the survey response data collected and electronically recorded by Hays, and then analyzing and tabulating the results. Sierra performed this phase.

Two key issues arose during the course of the effort that deserve mention.

First, when performing the field consistency and validation checks on the response data, roughly 100 data records either had inconsistencies between interrelated data responses or were outside reasonable limits. Sierra prepared a detailed list of each of these errors/inconsistencies and transmitted it to Hays. After collective review, it was agreed that most of these errors/inconsistencies could be fairly easily corrected by simply editing specific fields in the response database. For example, in the initial section of the survey where the types of heating devices available in each household are recorded, a wood-burning device may have been recorded with a "No" value, even though subsequent

sections of the survey reflected use of a wood-burning device Hays confirmed that cases like these were clear instances where the response in the initial section was incorrect (as corroborated by the types of data subsequently recorded for that household). In this example, the response in the initial section was simply changed from "No" to "Yes."

These types of corrective edits were made only when it was clear what should have been entered into the response database. For those 12 records where the intended responses could not be clearly inferred and corrections could thus not be made, Hays re-sampled "replacement" households.

Second, under the analysis phase of the effort Sierra also planned to perform a series of comparisons of key device counts and usage rates between the 2006, 2007, and 2010 survey data to look for trends and examine usage variations in the samples. While integrating the similarly validated data from the 2006 and 2007 surveys, it was recalled that the ZIP-code-specific sampling targets (and households sampled) in the 2006 and 2007 survey were developed using a different approach to that taken for the 2010 survey. To ensure proper comparisons across the survey samples, the ZIP-code tabulated results from these earlier surveys were re-weighted to composite totals using the same weightings from the 2010 survey. This was not a trivial effort, but was necessary to ensure the comparisons across survey samples were not biased by differing sampling strategies and thus potentially misleading.

Key Findings - Key results from the 2010 survey included tabulated estimates of the number and types of heating devices used within the PM2.5 nonattainment area, as well as per household usage rates for each type of device based on the survey responses.

Device Counts - First, Table 1-1 summarizes the counts of devices found in the survey sample along with estimates of total heating devices within the entire Fairbanks $PM_{2.5}$ nonattainment area. The device types are identified by both a short code and descriptive name as well as indentation in the leftmost column of Table 1-1 to clarify the separate sub-categories reported within the wood-burning sector. As shown in the highlighted "Nonattainment Area" column, woodstoves and central oil furnaces are the most common heating devices, with estimated counts of 7,980 and 21,130, respectively, over the entire nonattainment area. Of the combined total of 8,610 free-standing woodstoves and fireplaces with inserts, roughly one-third (2,930) are un-certified (pre-1988) models. In addition, almost all of the woodstoves and fireplaces with inserts burn cord wood (8,520). Only 370 were estimated to burn wood pellets based on the limited number of pellet-burning respondents (four) in the survey.

Fireplaces without inserts, estimated at a relatively small population of 540 according to Table 1-1, may nevertheless be significant contributors to the emission inventory from wood-burning devices. This is due to the fact that their heating efficiency is much less than those equipped with inserts or woodstoves.

The estimates of appliance counts are subject to statistical uncertainty as in any survey. The uncertainty in the estimate depends on the total sample size and the counts observed by appliance type in the category, being relatively larger for the categories with a small number of devices.

Table 1-1
2010 Survey Sampled Heating Devices Counts and Estimated Counts within the Fairbanks $PM_{2.5}$ Nonattainment Area

Heating Device Type	Number of Devices		Standard Error	Probable Range
	Survey Sample	**Nonattainment Area**		
1 - Wood-Burning Device	108[a]	**9,240**	±810	8,400 - 10,000
1a - Fireplace without insert	6[a]	**540**	±210	330 - 750
1b - Fireplace with insert	7[a]	**630**	±230	400 - 860
1c - Woodstove	89[a]	**7,980**	±740	7,200 - 8,700
All Inserts & Woodstoves (1b+1c)	96[a]	**8,610**	±770	7,800 - 9,400
Stove/Insert, Uncertified	31[a]	**2,930**	±480	2,500 - 3,400
Stove/Insert, Certified	60[a]	**5,680**	±650	5,000 - 6,300
Stove/Insert Using Cord Wood	90[a]	**8,250**	±750	7,500 - 9,000
Stove/Insert Using Pellets	4[a]	**370**	±180	190 - 540
1d - Outdoor Wood Boiler	1[a]	**90**	±90	0 - 180
2 - Central Oil Furnace	247	**21,130**	±920	20,200 - 22,100
3 - Portable Heater	11	**940**	±280	660 - 1,220
4 - Direct Vent Heater	53	**4,530**	±590	3,900 - 5,100
5 - Natural Gas Heating	16	**1,370**	±340	1,000 - 1,700
6 - Coal Heat	4	**340**	±170	170 - 510
7 - District Heat	7	**600**	±220	370 - 820
8 - Other	22	**1,880**	±390	1,500 - 2,300
All Heating Devices	**468**	**40,040**	**±1,510**	**38,500 - 41,600**

[a] Survey sample counts within the wood-burning sector do not match total due to "unknown" responses.

For example, smaller size count estimates shown in Table 1-1 for devices such as outdoor wood boilers and coal heating devices, are likely to reflect a higher degree of uncertainty because of the fact that very limited amounts of these devices were found in the 299-household survey sample.

The two rightmost columns in Table 1-1 show these computed statistical uncertainties reflected in the device count estimates for the entire nonattainment area. The uncertainties are quantified using the statistical formula for the standard error of a proportion,[*] based on the total sample size of 468 appliances and the estimated appliance count expressed as a percent of the total. For example, there are 247 oil furnaces in the survey or 52.8% of the total. The standard error of estimate for this proportion is ±2.3% in a survey of 468 appliances, meaning that the actual percentage of oil furnaces will fall

[*] See, for example, Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, Milton, J.S., J.C. Arnold – Third Edition. Irwin McGraw-Hill. Boston, MA. 1995. pp 321-323.

within the range from 50.5% to 55.1% with 68 percent probability (the probability under the normal distribution curve between +1 and -1 standard deviations from the mean). The uncertainty in the proportion of oil furnaces translates into an uncertainty of ±920 units in the estimated population of 21,130 oil furnaces. The probable range is the number of oil furnaces likely to exist within the non-attainment area with 68 percent probability. There will be only about 1 chance in 3 that the actual number will fall outside this range – being either less than 20,200 or more than 22,100. The statistical uncertainties were estimated in this manner at the most detailed response level of the survey and then aggregated up to estimate uncertainties in category totals and for the entire appliance population in the non-attainment area.

To simplify interpretation of the table, the estimated numbers of appliances in the non-attainment area and the associated standard errors have been rounded to the nearest 10 units, and the probable range for the number of appliances of each type has been rounded to the nearest 10 or 100 units depending on the size of the category.

(As indicated with a footnote in Table 1-1, individual device counts from the survey sample for individual types of wood-burning devices do not sum to the total number of reported wood-burning devices from the survey. This is due to the fact in some instances, although respondents indicated the household had a wood-burning device, they were unsure which type it was or what its certification status was. Section 4 of the report explains how these unknown sub-types were handled.)

(Section 4 of the report includes a more detailed discussion of the statistical uncertainty reflected in the 2010 survey data.)

As explained in greater detail later in the report, the device count estimates in Table 1-1 were developed by extrapolating the number of devices recorded in the 299-household survey sample to the entire nonattainment area based on household counts by ZIP code from the 2000 U.S. Census.

Table 1-2 summarizes the difference between the total number of households in the nonattainment area and the number of sampled households by ZIP code. The ratio of total-to-sampled households is shown in the bottom row of Table 1-2. This extrapolation factor was used to expand the number of home heating devices counted in the survey sample to the estimates for the entire nonattainment area presented earlier in Table 1-1.

Table 1-2
Comparison of Total Households and Survey-Sampled Households by ZIP Code

Parameter	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Total Households	7,164	1,822	5,329	8,774	2,389	105	25,583
Sampled Households	86	21	61	102	28	1	299
Extrapolation Factor	*83.30*	*86.76*	*87.36*	*86.02*	*85.32*	*105.00*	*85.56*

The differences between the number of households in the survey sample and entire nonattainment area listed in Table 1-2 need to be kept in mind when interpreting average household fuel usage rates and heating costs by device type, which are presented in the following two tables.

Fuel Usage and Heating Costs by Equipped Household – Table 1-3 summarizes average fuel use rates (the amount of fuel per season or year) and heating costs by device type for households equipped with or using each device/fuel from the survey sample. As reflected in both the individual ZIP codes and the entire sample (shown in the rightmost column labeled "All"), winter* heating device usage rates or costs were an overwhelming portion of annual totals. This is not surprising given the strong seasonal variations in ambient temperature and resultant heating demand experienced in Fairbanks.

Table 1-3
Wood Burning, Heating Oil and Other Fuel Usage Rates and Heating Costs per Equipped Household from the 2010 Survey

Device Type & Fuel	Usage Period	Dntown 99701	Wnwrght[a] 99703	Nth Pole 99705	Airport 99709	Steese 99712	Univ 99775	**All**
Stove/Insert Wood Use (cords)	Annual	3.50	3.50	5.23	3.54	3.30	n/a	3.95
	Winter	3.10	3.25	4.71	3.28	2.70	n/a	3.60
Fireplace Wood Use (cords)	Annual	n/a	n/a	6.00	4.00	n/a	n/a	5.20
	Winter	n/a	n/a	5.67	3.00	n/a	n/a	4.60
Central Oil Use (gal)	Annual	1,258	1,083	996	1,141	1,053	n/a	1,135
	Winter	805	875	749	883	781	n/a	818
Portable Heater Fuel Use (gal)	Annual	n/a	n/a	20	2	300	n/a	107
	Winter	n/a	n/a	20	2	300	n/a	107
Direct Vent Heater Fuel Use (gal)	Annual	700	n/a	733	403	417	n/a	493
	Winter	625	n/a	633	311	417	n/a	444
Natural Gas Fuel Cost (dollars)	Annual	$1,950	$900	n/a	$2,717	n/a	No data	$2,159
	Winter	$1,700	$700	n/a	$1,180	n/a	No data	$1,260
District Heat Fuel Cost (dollars)	Annual	$2,800	$2,000	n/a	n/a	n/a	n/a	$2,400
	Winter	$1,500	$1,200	n/a	n/a	n/a	n/a	$1,350

[a] Also includes Birch Hill area
n/a – Not applicable (i.e., indicates where a device was not found in the sample for a specific ZIP code)

As shown in Table 1-3, fuel usage estimates were available for most of the surveyed heating devices: wood-burning devices, central oil furnaces, and portable and direct-vent heaters. Winter fuel usage for the two most common heating devices—central oil furnaces and woodstoves—was 818 gallons of heating oil and 3.60 cords of wood, respectively.

* In the 2010 survey, winter usage was defined as that from October through March.

For those heating devices such as natural gas or District heating where the amount of fuel is less well known, the survey respondents were asked to provide usage estimates in the form of heating costs for each device. The seasonal and annual natural gas and District heating costs presented in Table 1-3 represent averages of respondent estimates across those households where each device was used.

Wood-Burning Usage Patterns – On average, Table 1-3 indicates that those households equipped with woodstoves or fireplaces with inserts burned 3.60 cords of wood during the October through March winter months and 3.95 cords annually. Households using fireplaces without inserts (referred to in Table 1-3 and subsequent tables as simply "fireplaces") exhibited greater average wood use: 4.60 cords during winter and 5.20 cords over the entire year. Though not shown in Table 1-3, the single household identified in the survey using an outdoor wood boiler indicated that they burned a total of six cords, all during winter.

The higher wood usage for fireplaces without inserts seen in Table 1-3 is consistent with the point raised earlier that they have much lower effective heating efficiency than fireplaces equipped with inserts or woodstoves. More wood must be burned in these "no-insert" fireplaces to deliver the same amount of effective heat. As it relates to their contribution to emissions inventory, a key question is how are fireplaces without inserts used, as primary or significant heating sources, or more for ambiance/aesthetics and less for heating?

In the 2010 survey sample, a total of six households were found that had no-insert fireplaces as a home heating device. Of these six households, all but one (83%) indicated that they used their fireplaces as a heating source during winter at least 40% of the time. In one household, the no-insert fireplace was the sole heating device; the respondent indicated that a total of eight cords of wood was burned during winter. In addition, all of these six respondents indicated they either cut their own wood, or both buy and cut their wood. This suggests that at least in these households, wood costs may be less of a factor than in other wood-burning households.

Though this is a very limited sample, usage practices of fireplaces without inserts from the 2010 survey suggest they were not simply used as minor heating source or simply for ambiance, but burned large amounts of wood and were used as major, if not primary, household heating sources. By comparison, homes equipped with fireplace inserts or woodstoves used these devices 31% and 50% of the time during winter, respectively, based on respondent estimates from the 2010 survey.

A quick review of households containing fireplaces without inserts from the 2006 and 2007 survey data was performed to see if similar practices were observed in those previous samples. In both of these samples, a different pattern was seen. These samples contained 16 and 20 households, respectively, with "no-insert" fireplaces. In each sample, only a single household was identified as using its fireplace as a significant heating source (defined as 40% of more) during winter. Thus, the fraction of no-insert fireplaces used as a significant heating source based on these survey samples was 5-6%, much less than found in the 2010 survey. Not coincidentally, wood use in these two

households was significant: 3-4 cords during winter. In the remaining "occasional fireplace use" households from the 2006 and 2007 survey, average household winter wood use was roughly one cord.

This disparity between usage patterns of no-insert fireplace households between the 2010 and earlier survey samples indicates that individual no-insert households exhibit significant wood-burning emissions, although extrapolating these disparate usage patterns to all no-insert households in the nonattainment area reflects a high degree of uncertainty. Usage practices in no-insert households clearly need to be better understood.

(Two cells Table 1-3 are listed as "No data." For the one household sampled in this ZIP code, the respondent did not provide natural gas heating cost estimates.)

Fuel Usage and Heating Costs by Any Household – The seasonal and annual usages and heating costs presented earlier in Table 1-3 are not to be confused with averages across all households in the sample, whether or not a household had or used a specific type of heating device. Averages across all households (i.e., any household), which provide a better basis for calculating emission inventories, are displayed in Table 1-4.

Table 1-4
Wood Burning, Heating Oil and Other Fuel Usage Rates and Heating Costs per Household (Any Household) from the 2010 Survey

Device Type & Fuel	Usage Period	Dntown 99701	Wnwrght[a] 99703	Nth Pole 99705	Airport 99709	Steese 99712	Univ 99775	**All**
Stove/Insert Wood Use (cords)	Annual	0.53	0.83	2.23	1.42	1.30	n/a	**1.27**
	Winter	0.47	0.77	2.01	1.32	1.06	n/a	**1.15**
Fireplace Wood Use (cords)	Annual	n/a	n/a	0.30	0.12	n/a	n/a	**0.10**
	Winter	n/a	n/a	0.28	0.09	n/a	n/a	**0.09**
Central Oil Use (gal)	Annual	1,141	619	833	906	940	n/a	**938**
	Winter	730	500	626	701	697	n/a	**676**
Portable Heater Fuel Use (gal)	Annual	n/a	n/a	0.98	0.08	10.71	n/a	**3.95**
	Winter	n/a	n/a	0.98	0.08	10.71	n/a	**3.95**
Direct Vent Heater Fuel Use (gal)	Annual	90	n/a	84	87	104	n/a	**87**
	Winter	80	n/a	73	67	104	n/a	**79**
Natural Gas Fuel Cost (dollars)	Annual	$113	$171	n/a	$133	n/a	No data	**$116**
	Winter	$99	$133	n/a	$58	n/a	No data	**$67**
District Heat Fuel Cost (dollars)	Annual	$65	$381	n/a	n/a	n/a	n/a	**$56**
	Winter	$35	$229	n/a	n/a	n/a	n/a	**$32**

[a] Also includes Birch Hill area
n/a – Not applicable (i.e., indicates where a device was not found in the sample for a specific ZIP code)

Average device usage rates and heating costs on this any-household basis in Table 1-4 are by definition, lower than corresponding values presented earlier in Table 1-3. This is

because the denominator or number of households being averaged in Table 1-4 is always larger, and in many cases significantly larger, than the number of equipped households on which the Table 1-3 averages are based.

The difference between the two sets of averages in Tables 1-3 and 1-4 are perhaps best explained by example. According to Table 1-3, average winter wood use in households equipped with woodstoves or fireplaces with inserts was 3.60 cords. This average represents only those households within the survey with these wood-burning devices. As reported earlier in Table 1-1, the total number of woodstove or fireplace-with-insert households in the survey sample was 96 (7 + 89). The total amount of wood burned across these households is 345.6 cords (96 equipped households × 3.60 cords/household). The total number of households in the survey sample, irrespective of which heating devices they used, was 299. Thus, the average winter woodstove/insert use across all (or any) households in the survey sample is 1.15 cords (345.6 total cords ÷ 299 total households) as reported in Table 1-4.

Although less intuitive, this same averaging approach was applied to the heating cost estimates for natural gas and District heating shown at the bottom of Table 1-4. In these cases, the averages across all households in the survey are much lower than the equipped household averages given in Table 1-3 because these heating devices were less common.

Comparisons Across Surveys – Finally, Table 1-5 presents a comparison of key tabulations from each of the three separate Fairbanks Home Heating surveys: 2006, 2007, and the current 2010 survey. As explained earlier, the tabulations from the earlier surveys were re-weighted by ZIP code using the same weightings on which the 2010 survey was based for consistency when compared with the 2010 results. Highlighted cells in Table 1-5 identify key metrics where significant changes were observed in the 2010 survey compared to the earlier surveys.

First, the overall percentage of wintertime wood-burning device use increased to over 17% in the 2010 sample (over usage fractions of 10-12% in the earlier surveys). In addition, the distribution of wood-burning devices used has changed: no-insert fireplace use is lower in the 2010 sample (5.8%), while woodstove use is higher (86.4%). Within the populations of woodstoves and fireplaces with inserts in the survey samples, the fraction of un-certified stoves/inserts has dropped markedly from 52.4% in 2006 to 34.1% in 2010. On the other hand, winter wood usage (i.e., the amount burned per wood-burning household) has increased noticeably for both stoves/inserts and no-insert fireplaces. (As discussed earlier, the variations observed for the no-insert fireplaces may be related to small sample sizes.)

Beyond the wood-burning sector, Table 1-5 also highlights a clear reduction in the wintertime central oil use. Although the usage fraction for central oil furnaces (the respondent-estimated fraction of use within the household) had remained fairly steady, between 63.9% and 68.0% as reported in the upper section of Table 1-5, usage amounts (gallons of fuel oil) per household dropped nearly 20% in the 2010 sample (818 gallons) compared to the earlier surveys.

Table 1-5
Summary of Key Results from 2006, 2007 and 2010 Home Heating Surveys

Statistic	Parameter	Survey Results		
		2006[a]	2007[a]	2010
Average Winter Device Use by Type (% of Household Use)	Wood	**10.1%**	**11.8%**	**17.2%**
	Central Oil	68.0%	63.6%	67.3%
	Portable	0.7%	0.5%	0.2%
	Direct Vent	8.6%	7.4%	8.2%
	Natural Gas	2.6%	2.3%	4.5%
	Coal Heat	n/a	n/a	0.5%
	District Heat	2.8%	1.1%	1.3%
	Other	7.2%	13.4%	0.7%
Wood Burning Type (% of Wood-Burning Devices)	Fireplace	**13.0%**	**17.5%**	**5.8%**
	Fireplace + Insert	8.3%	5.6%	6.8%
	Woodstove	**78.8%**	**76.9%**	**86.4%**
	Wood Boiler	n/a	n/a	1.0%
Wood Stove/Insert Cert Type (% of Woodstoves/Inserts)	<1988 (Un-Certified)	**52.4%**	**46.8%**	**34.1%**
	≥1988 (Certified)	**47.6%**	**53.2%**	**65.9%**
Stove/Insert Wood Use (cords), Winter	Winter Season	**2.87**	**2.85**	**3.60**
Fireplace Wood Use (cords), Winter	Winter Season	**0.76**	**0.74**	**4.60**
Central Oil Use (gallons), Winter	Winter Season	**1,099**	**1,011**	**818**
Portable Heater Fuel Use (gallons), Winter	Winter Season	91.7	152.7	107.3
Direct Vent Heater Fuel Use (gallons), Winter	Winter Season	296	472	444
Natural Gas Heating Fuel Cost (dollars), Winter	Winter Season	**$553**	**$947**	**$1,260**
Municipal Heating Fuel Cost (dollars), Winter	Winter Season	n/a	n/a	$1,350

[a] Winter usage in these surveys encompassed October-May; 2010 winter usage spanned October-March.

To understand the possible causes of this decrease in central oil usage, an analysis of wintertime Fairbanks heating degree days[*] was conducted. Comparisons of degree days during the same six-month winter periods of each survey indicated that ambient temperature-based heating demand in 2010 was roughly 94% of the winter average of 2006 and 2007. Therefore, most of the 20% decrease in central oil usage seen in the 2010 survey was not the result of year-to-year ambient temperature variations. The other likely explanations for this decrease are either: 1) participation in the recently-initiated Alaska Home Energy Rebate Program[†]; or 2) a shift to other devices/fuels resulting from market prices of heating oil. (An analysis of the effects of participation in the Home Energy Rebate Program was beyond the scope of this study.)

[*] Calculated 65°F heating degree days at Fairbanks International Airport (PAFA), www.degreedays.net
[†] Alaska Housing Finance Corporation, http://www.akrebate.com/rebate_about.aspx

A significant increase in wintertime natural gas heating costs per equipped household is also highlighted in Table 1-5. Costs per household have more than doubled from $553 in 2006 to $1,260 in 2010. Whether this reflects a greater usage of natural gas heating is unclear; no analysis of changes in residential natural gas heating prices over this four-year period was performed. However, as also reported in Table 1-5, respondent-estimated usage fraction for natural gas heating increased from 2.6% in 2006 to 4.5% in 2010.

As footnoted in Table 1-5, one element that was not fully consistent across the three surveys was the definition of winter season activity. For the 2006 and 2007 surveys, winter was defined as October through May; as noted earlier, the 2010 survey defined winter as October through March. Rather than try to adjust[*] the results data from the earlier surveys downward to reflect the shorter winter period in the 2010 survey, this difference is simply noted. Thus, the higher winter season usage seen in the 2010 survey would be further magnified if a seasonal adjustment were made.

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[*] Given the strong relationship between ambient temperature and residential heating demand/activity, it is not appropriate to simply adjust the 2006 and 2007 usage data by the difference in winter periods across the three surveys (i.e., by a factor of 6/8 months.) because historical April-May ambient temperatures tend to be much warmer than the average from October-March.

2. INTRODUCTION

This introduction provides a review of the background behind the effort, the project objectives, and the organization of the remainder of the report.

2.1 Background

Fairbanks has been collecting measurements of fine particulate ($PM_{2.5}$) concentrations at the State Office Building in the downtown area for over a decade. Those measurements show a distinct seasonal pattern of elevated concentrations during both summer and winter months. Large, uncontrolled wild fires are the principal cause of the elevated summer values. The causes of the elevated winter values are more complex and include severe meteorology (i.e., low wind speed, low mixing depth heights, and arctic winter temperatures) that limit dispersion potential, combustion of fuel for space heating and power production as well as poorly understood atmospheric chemistry that promotes secondary particulate formation. Collectively, these factors have caused the Borough to routinely exceed the more stringent 35 $\mu g/m^3$ National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$ that the U.S. Environmental Protection Agency (EPA) established in 2006, and resulted in Fairbanks being designated as a $PM_{2.5}$ nonattainment area in December 2009.

ADEC has sponsored this study to collect information on the types and usage rates of residential heating equipment and fuels in Fairbanks. The specific heating devices/fuels that were surveyed are listed below.

- Wood-burning devices (fireplaces, fireplaces with inserts and woodstoves)
- Central oil furnaces
- Portable fuel oil/kerosene devices
- Direct-vent type heaters such as Toyo or Monitor brands
- Natural gas heating
- Coal heating
- District* heating (from circulated steam)

The study method was a telephone-based survey conducted by Hays Research Group (Hays) over a sample of roughly 300 residential households in Fairbanks. The survey

* The household survey form and electronic response database use the term "Municipal Heating" to refer to district heating provided within portions of the Fairbanks area from steam circulated in underground pipes. For this point in the report forward, district and municipal heating refer to this same type of steam heating.

consisted of a total of 71 "tiered" questions organized and asked in a hierarchical structure based on the types of heating devices that each respondent indicated were used within the household. Respondents were generally queried about the types and usage rates (e.g., fuel burned or costs incurred per season or year) for each device/fuel type used. Given the likely significance of the emissions contribution from wood-burning to total $PM_{2.5}$ emissions during cold wintertime conditions, the survey included additional questions related to the types and ages of specific wood-burning devices to aid in quantifying emission estimates for this source sector.

Unlike the earlier 2006 and 2007 surveys, this 2010 survey also included questions on wood drying practices and estimated moisture content. The responses on wood drying practices and estimated moisture content will be used in conjunction with direct measurements of wood usage and moisture content from a subset of the wood-burning households identified in this survey that are being collected under a separate concurrent study being performed by the Cold Climate Housing Research Center (CCHRC). Energy content (and thus emission rates) is known to vary significantly with wood moisture content. Recoverable heat energy per pound from dry wood is about 2.5 times higher than that from wet wood (60% moisture content).[*] There is concern that as wood-burning usage has increased over the last several years in response to higher heating oil prices, dried wood supplies may have become more limited.

As with the earlier surveys, the 2010 survey targeted a total of 300 households. Within this overall target, the sample was stratified by ZIP code based on the number of households within each ZIP code according to 2000 U.S. Census. Table 2-1 shows the households by ZIP code and the resulting sampling targets by ZIP code for the six ZIP code areas contained within the $PM_{2.5}$ nonattainment area.

Table 2-1
Household Survey Sampling Targets by ZIP Code

ZIP Code	Area	Households[a]	Household Fraction (%)	**Sampling Target**
99701	Downtown	7,164	28.0%	84
99703	Wainwright & Birch Hill	1,822	7.1%	21
99705	North Pole	5,329	20.8%	62
99709	Airport	8,774	34.3%	103
99712	Steese	2,389	9.3%	28
99775	University	105	0.4%	1
TOTALS		25,583	100%	**300**

[a] from 2000 U.S. Census

[*] http://www.treesearch.fs.fed.us/pubs/5783

The polled residences were household-weighted across each of the ZIP codes located within the Fairbanks $PM_{2.5}$ nonattainment area. This enabled the resulting sample to be "self-weighting" across ZIP codes within the area.

Use of this self-weighting sampling strategy was important in proportionately accounting for different heating types available within specific portions of the nonattainment area (e.g., District heating in the Downtown and Wainwright areas). However, the downside of this approach is that ZIP code areas with few households such as University (99775) result in very small sample sizes that tell less about variations in heating devices and equipment within these areas.

To better explore this secondary objective of examining within ZIP area variations, future surveys, if performed, could be designed to oversample these smaller areas.

2.2 Project Objectives

As noted in Section 1, Sierra and Hays had conducted similar ADEC-funded Fairbanks home heating surveys in 2006 and 2007. Results from both those surveys showed a clear and significant increase in wood burning-based heating in recent years resulting from the large run up in home heating oil prices compared to wood burning estimates compiled in earlier emission inventories.[*] ADEC funded this latest survey (conducted during early 2010) to ascertain whether this trend has continued and to gain information about other heating types and fuels, such as outdoor wood boilers and coal, that were not explicitly identified in the earlier 2006 and 2007 surveys.

The results of this latest 2010 survey are also being used to produce updated winter-season residential space heating emission estimates within emission inventories being developed in support of the Fairbanks $PM_{2.5}$ State Implementation Plan (SIP), which must be completed by December 14, 2012.

The primary objectives of this report are as follows:

- Describe the structure and content of the collected survey data;
- Document techniques used to validate the raw survey data collected by Hays;
- Present detailed tabulations of the validated data; and
- Discuss key findings from the survey.

2.3 Organization of the Report

Beyond this introduction, the remainder of the report is organized as follows: Section 3 describes the structure and content of the survey data as well as the data handling and validation procedures applied by Sierra to the data as-received from Hays; and Section 4

[*] L. Williams, et al., "Criteria Pollutant Inventory for Anchorage, Fairbanks, and Juneau in 2002, 2005 and 2018 – Draft Report," prepared by Sierra Research for Alaska Department of Environmental Conservation, July 13, 2007.

describes the analysis performed on the validated survey data and presents results and key findings from analysis of the data. A series of appendices provides a copy of the survey that was used and more detailed information on the survey results.

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3. DATA HANDLING AND VALIDATION

Telephone survey protocols can be designed and implemented in a manner that minimizes errors in recording the responses as they stated on the phone while the survey is conducted. Nevertheless, mistakes in recording responses can arise simply from data entry errors as the person administering the survey tries to both listen and record categorical or numeric responses as quickly as possible.

As a result, in addition to the internal quality assurance procedures employed by Hays, Sierra applied a series of independent checks to the as-received survey data. These quality assurance and data validation checks are described in this section, following a summary of the content and form of the survey data files obtained from Hays.

3.1 Description of As-Received Data

Survey Content – As summarized earlier, the home heating survey consisted of a total of 71 separate questions that were asked of each household in a "tiered" structure. In other words, based on answers to questions about the types of heating devices/fuels asked at the beginning of the survey, additional questions related to each type of device used were then asked. These key "device type" questions encompassed the first eight questions of the survey and simply asked the respondent to reply either "Yes," "No," or "Don't Know" when asked whether any of the following devices were used for household heating:

1. Wood-burning device;
2. Central oil furnace;
3. Portable fuel oil/kerosene heater;
4. Toyo, Monitor, or other type of direct-vent heater;
5. Natural gas heating;
6. Coal heating;
7. Municipal heating; or
8. Other (not listed above).

For these initial questions (Q1-Q8), respondents were specifically asked to identify multiple heating types used within the household from this list, if applicable. In addition, respondents were asked to provide or estimate the size of their homes (in square feet of living space).

Beyond these initial questions about device/fuel types, the survey then branched to specific questions about individual devices within a particular group (e.g., fireplaces, inserts, or woodstoves). It also included questions about usage rates during both winter (October-March) and on an annual basis. Table 3-1 describes the sections of the survey and identifies the range of questions by number for each "branch" of the survey based on the types of heating devices used in the household that are determined from responses to the initial section of the survey (Q1-Q9). As highlighted in Table 3-1, the initial and end sections of the survey were asked of all respondents. Questions for other sections were heating type-specific and asked only when those devices were used in each household.

Table 3-1
Layout of 2010 Home Heating Survey

Section No.	Section Name	Question Range
0	**Initial Section – Heating devices used and percentages of heat supplied by device, asked of all respondents**	**Q1-Q9**
1	**Woodstove/Fireplace Insert** – asked only if respondent uses woodstove or fireplace with insert	Q10-Q23
2	**Wood-Burning Fireplace** – asked only if respondent uses fireplace without an insert	Q24-Q31
3	**Outdoor Wood Boiler** – asked only if respondent uses outdoor wood boiler	Q32-Q40
4	**Central Oil** – asked only if respondent uses a central oil furnace	Q41-Q44
5	**Portable/Kerosene Heater** – asked only if respondent uses portable fuel oil or kerosene heating device	Q45-Q50
6	**Direct-Vent Heater** – asked only if respondent uses Toyo, Monitor or other type of direct-vent heater	Q51-Q54
7	**Natural Gas Heating** – asked only if respondent uses natural gas heating device	Q55-Q56
X	**Coal Heating** – asked only if respondent uses coal-fired heating device	Q57-Q60
F	**Municipal Heating** – asked only if respondent uses steam heat from underground piping supplied by the municipality or military	Q61-Q62
End	**Future Section – questions pertaining to planned/future heating practices, asked of all respondents**	**Q63-Q71**

The usage questions were of two types. First, in the initial section of the survey when respondents were asked to identify the types of heating devices used in their household, they were then asked to estimate the percentage of heating supplied by each device used

during the October-March winter months. Second, within each device-specific section, respondents were also asked to estimate both winter season and annual usage rates in units specific to each device (e.g., cords of wood for wood-burning, gallons of fuel oil for central oil furnaces, etc.).

For respondents using a wood-burning device, the survey further included questions about the source of wood (purchased or cut by themselves), whether the wood is seasoned for a period before being burned, and the estimated moisture content of the wood.

At the end of the survey, respondents were also asked a series of questions about changes they planned to make in the mix or types of home heating devices currently being used. Within this final section of the survey, wood-burning households were also asked whether they burned more wood this winter than last and to estimate the reduced fuel oil price that would cause them to shift from wood use to heating oil.

Appendix A presents the complete 2010 questionnaire/script used by Hays personnel to conduct the telephone-based surveys. It also identifies the individual branching sections that were used as each household was surveyed and asked detailed follow-up questions that pertained only to the heating types used in that household. This dynamic branching approach minimized the time needed to survey each household and avoided needlessly leading respondents through a series of questions that were not applicable to their specific heating types.

As-Received Data – The primary telephone survey data collected by Hays were provided to Sierra in Excel spreadsheet format. In addition, secondary data collected from the survey were provided in a series of Rich Text Format (RTF) files. These secondary data files include several elements of the survey results that couldn't be fit easily into the structure of the primary spreadsheet. Examples of these secondary data included short phrase descriptions of heating devices categorized as "Other" that were not represented in the specific devices queried; or responses to Question 57 about annual coal usage, which allowed the respondent to provide usage estimates in either of two different units, tons or bags. Information in these secondary RTF files was also loaded into the analysis spreadsheet in a separate data sheet from the primary data. The columns of the primary data sheet were organized by each survey question, along with date, phone number and zip code. Each row in the primary sheet represented collected data from a specific household.

The initial as-received survey spreadsheet provided from Hays contained responses for a total of 300 randomly selected households, sample-weighted by ZIP code as explained earlier in Section 2.1.

Sierra loaded the primary response and supplemental data provided by Hays into an analysis spreadsheet called ***FNSB_2010_Survey_Tabulations.xls*** provided as a separate electronic deliverable under this effort. The as-received primary data were loaded into this workbook in a sheet named *RawData*. The secondary responses tables from the RTF files were loaded into separate areas in a sheet named *SupplementalData* within this analysis spreadsheet.

3.2 Quality Assurance and Validation Procedures

Once the survey data files were transmitted from Hays to Sierra, a series of data handling, quality assurance checks, and validation procedures were applied to the as-received data. These data validation checks are described in this sub-section.

Numeric Data Conversions - All the numeric responses in the spreadsheet provided by Hays were stored as text strings rather than as numbers; mathematical tabulations or range check operations could not be properly performed on these values as text. So the first step applied by Sierra to the as-received data consisted of converting these text values to numbers. (The Excel VALUE function was used to perform these text-to-numeric conversions.) The converted data were stored in a separate sheet in the analysis workbook called *ClnData* upon which a series of data validation and consistency checks were then applied.

Field Consistency Checks – As noted earlier, the telephone surveys were conducted in a branching manner whereby once each respondent's heating devices were identified, additional follow-up questions were asked about each device used in the household. As a result, specific fields in the survey database should exhibit relational dependencies. When expected relational dependencies for specific fields within a household data record were not found, an error was flagged.

For example, if a respondent indicated use of a wood-burning device (Q1=1 for "Yes"), the data field for Questions 1a (Q1a) should have a value ranging from 1 to 5 to represent one of the following types of wood-burning devices:

1. Fireplace (no insert);
2. Fireplace with insert;
3. Wood-burning stove;
4. Outdoor wood boiler; or
5. Don't know or refused to respond.

A field consistency check was applied for the responses in the Q1 and Q1a fields to ensure that if Q1 (Do you use a wood-burning device?) was 1 or "Yes" that the Q1a values had to range from 1 through 5. If a blank entry was found in Q1a when Q1 was 1, or conversely if Q1a had values from 1 through 5 and Q1 was 2 (No) or 3 (Don't Know/Refused to Respond), a consistency error was flagged for that household record in the survey database.

Because the survey questions were designed and asked in a branching, hierarchical manner, there were a large number of fields in the response database for which relational rules existed and field consistency checks were applied. Roughly 20 separate sets of related field consistency checks were applied to the survey response data records. These consistency checks were useful for ensuring that consistent data entries were made for each household survey record.

Data Validation Procedures – In addition to the related field consistency checks, a series of data range checks were applied to specific numeric fields such as fuel usage fields. These range checks were applied to reduce the likelihood that data entry errors (e.g. where an extra zero was added) produced outlier values that affected statistical tabulations of the data. Examples of data fields where range check validations were applied are summarized below.

- *Q16) How many months do you season your wood before burning it* – Values of 60 or greater (5 years) ending in zero were assumed to be entry errors where a zero was inadvertently added in entering the response. (One instance of this error was found where an entry of 120 was corrected to 12.)

- *Q18) Amount of wood burned annually with stoves/inserts (in cords)* – Values of 10 cords or more were checked against the wood-burning device type listed in Q1a and the wood-burning heating fraction given in Q9a. These values were only considered valid if used in outdoor wood boilers or if home heating was at least 80% supplied by wood-burning.

- *Q19) Amount of wood burning from October to March with stoves/inserts (in cords)* – The same 10 cord upper limit as in Q18 was applied to the Q19 entries. In addition, the values in Q18 (annual usage) and Q19 (winter usage) were compared. If the winter value was greater than the annual value, they were generally corrected by switching the entries for the two fields. (In one instance, an annual value of 3 and a winter value of 24 were entered. In conjunction with the fact that the wood heating fraction for this household was 60%, the winter value for this household was corrected to 2.)

- *Q20 and Q21) Amount of 40 lb wood pellet bags used annually and during winter with stoves/inserts, respectively* – Similar to the validation checks for Q18 and Q19, annual and winter pellet bag values were compared to each other. Where annual values were lower than winter, the original entries were switched between the two fields.

- *Q41 and Q42) Amount of central heating fuel oil used(in gallons) annually and during winter, respectively* – Similar limits and cross-checks to wood usage responses were also applied for entries of annual and winter central heating oil usage. An upper limit of 7,000 gallons was used to flag both annual and winter usage entries (which would represent an annual heating oil cost of $20,000 or more). For records with flagged entries, annual and winter usage values were compared to each other and to respondent estimates of annual heating oil cost and fractional heating usage within the household from a central oil furnace. In specific cases, it was apparent that either the annual and winter usage entries had been transposed or an extra zero had been added to an entry (e.g., 9,000 instead of 900).

These range validation checks were applied to both the primary data in the *ClnData* sheet as well as the secondary data in the *SupplementalData* sheet in the analysis spreadsheet.

In addition to these range validation checks, entries of "9999" used by Hays to represent missing or unknown values in numeric fields were corrected to blank or null values within the *ClnData* sheet in the analysis spreadsheet to prevent improper tabulation of maxima or means. (In Excel, a value of 9999 would be treated as an actual number, rather than a missing value that should not contribute to an average value across a group of observations. By setting the values for these entries to blank or null values, they are not used by Excel to compute an average across a range of cells.)

3.3 Issues Identified and Corrected

A number of data errors or inconsistencies were identified when the data validation and consistency checks described in Section 3.2 were applied to responses entered for each of the 300 surveyed households. These errors and issues and the corrective actions taken to address them are discussed in this sub-section.

Field Consistency Issues – A number of inconsistent responses were found, particularly in the fields related to heating devices used (Q1-Q8) and percentages of heat supplied by each device (Q9a-Q9h). The particular types of inconsistency issues identified are delineated below with their corrections.

- *Bad "Other" Data Entered* – One respondent entered "1" in Q8 asking about use of other heating devices that are not listed in Q1-Q7, then the type of other device in the secondary data table for this respondent was listed as "None." The Q8 response (any other devices used) should have been "2" and was corrected.

- *Device Type Wrongly Entered in Other* – In some instances, "other" heating devices used entered as a "1" in Q8 were already entered in the responses to Q1-Q7. For example, the other device listed in the Q8 response was a woodstove, even though Q1 (Do you use a wood-burning device) was entered as "2" (No). A total of four of these types of records were found. The problem with them is that the proper branching in the remainder of the survey was not conducted. With the woodstove example, no follow-up questions in the woodstove section of the survey (Section 1, Q10-Q23) were asked. Thus, these records were incomplete and were deleted from the valid response database.

- *Inconsistent Allocations* – In some records, the heating devices used in the household (identified with entries of "1" in Q1-Q8) did not match with a corresponding non-zero heating device usage percentage entered in Q9a-Q9h. For example, a wood-burning device was listed as used 50% of the time in Q9a, but the response to Q1 (Do you use a wood-burning device) was entered as "2" (No). A total of 19 household records were flagged based on inconsistent allocations. Of these 19 records, Hays confirmed that the inconsistencies in 11 of the records could be corrected by editing the percentage entries (from 0% to 100% or vice versa) in the Q9a-Q9h fields or the "1" or "2" usage entries in the

Q1-Q8 fields based on which branches or sections of the survey record had completed information. Sierra performed these corrections and documented the edits within the appropriate cells within the *ClnData* sheet in the analysis spreadsheet. The remaining 8 records were discarded.

- *Potentially Unreported Allocations* – Occasionally the respondent identified multiple heating devices used in Q1-Q8, but each of those devices was not assigned a non-zero usage percentage in the Q9a-Q9h fields, even though the Q9a-Q9h allocations added to 100%. A total of four households were found to exhibit these unreported allocations. At Sierra's request, Hays contacted these households and confirmed in all four cases that the unreported allocations occurred because each household had more heating devices than were actually used. For example, a household had a fireplace, a central oil furnace, and a direct-vent heater, but only used the fireplace and furnace. Thus, these records were confirmed to be valid as recorded.

- *Faulty Entries* – Questions 37 and 38 were supposed to be asked only if the respondent used an outdoor wood boiler. However, a total of 103 household records in the as-received database were found to contain non-blank entries in these fields when no outdoor wood boilers were listed as being used. Follow-up with Hays indicated that the programmed phone survey logic (which guided the surveyors through the device-specific section questions once the usage types were identified in the initial section) was faulty. Hays confirmed that these entries were errors resulting from the faulty logic and that the values in the Q37 and Q38 fields for those records should be deleted. Sierra edited the cells in these affected records to properly contain blank or null values.

Because of these consistency issues, a total of 12 household records from the as-received database were invalidated and removed from the survey sample. Hays was notified about these deleted records and re-sampled a replacement set of 12 new randomly selected households within the same ZIP codes as the original household records that were deleted. After this re-sampling, Sierra identified one other household record with likely errors that was discarded. Because of the timing, Hays was not asked to re-sample for this single additional discarded record.

Also after the re-sampling, 11 other household records were found with missing usage data (i.e., device-specific sections of the survey that should have been asked, but weren't). The reason they weren't discovered during the initial validation checks was that there were no field inconsistencies between the device types in the Q1-Q8 entries and the device usage percentages entered in Q9a-9h. Rather than eliminate these additional 11 records (and affecting the self-weighting nature of the ZIP code-stratified sample), their valid data for the Q1-Q8 and Q9a-Q9h fields were retained and their-specific usages were simply treated as missing.

Thus, the final household survey database consisted of a total of 299 household records.

Unreasonable Value Corrections – In addition to the errors/issues listed above, some of the survey responses for the usage values (e.g., amount of wood burned or heating oil used) were determined to be unreasonable based on the valid range checks and examination of other usage fields as summarized earlier in Section 3.2. As noted in Section 3.2 under "Data Validation Procedures," the unreasonable values could generally be corrected by examination of other related fields, or removal of a presumed extra trailing zero in these numeric usage fields. Within the ClnData sheet of the analysis spreadsheet, cells where these corrective edits were applied are marked with an Excel "pop-up" comment which identified the original and corrected value and included an explanation of the correction.

A total of 421 cell corrections were applied, although roughly 95% of these cell corrections were simply editing the Hays "9999" missing values to null values to ensure the Excel statistical tabulations were not improperly affected by missing data. Not counting these missing value edits, 16 of the 299 household survey records (5%) contained values that were identified as erroneous and corrected. Within the *ClnData* sheet, these are identified with tan/orange cell shading and a pop-up comment indicating what the original value was and why it was changed.

The resulting replacement records and cell corrections were reflected in the *ClnData* sheet in the analysis spreadsheet. These records represented the validated household survey data from which statistical tabulations were developed and described in the following section of the report.

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4. SURVEY ANALYSIS

Once the household survey response data had been checked for consistency and data values were validated, the final phase of the effort consisted of developing a detailed set of tabulations from the valid data and organizing the results into a series of understandable summaries that can ultimately be used to further update the space heating emission sector of the Fairbanks emissions inventory. These study elements are discussed in this section.

4.1 Development of Tabulations

Construction of Pivot Tables – Within the analysis spreadsheet accompanying this report, a series of detailed Excel "pivot tables" were constructed to produce cross-tabulations of the responses to each question in the home heating survey. (In Excel, pivot tables provide an efficient way to produce multi-tiered cross tabulations of detailed data.) The pivot tables were created in a consistent manner or layout as illustrated below in Figure 4-1, which shows a two-way tabulation of the responses to Question 1 of the survey (Does the household use a wood-burning device).

Figure 4-1
Pivot Cross-Tabulation of Q1 Responses

Q1 Heating Type - Wood Burning (1-Yes, 2-No, 3-DK)

Count	rzip						
q1	99701	99703	99705	99709	99712	99775	Grand Total
1	15	6	29	47	11		108
2	71	15	32	55	17	1	191
3							
Grand Total	86	21	61	102	28	1	299

The pivot table columns shown in Figure 4-1 contain record counts (i.e., household) by ZIP code and a total across all ZIP codes. The areas corresponding to each of the ZIP codes are Downtown Fairbanks (99701), Wainwright (99703), North Pole (99705), Airport (99709), Steese (99712), and University (99775). The pivot table rows stratify the record counts by the individual categorical responses recorded and include a total at the bottom. A "key" at the top of the pivot table explains what each coded response means. As shown in this key, survey questions for which possible responses were either

"Yes," "No," or "DK" (Don't Know) were coded with values of 1, 2, or 3, respectively. (As expected for the validated dataset, responses to this question were either 1 or 2.)

For other questions where there were more than three allowed responses, such as Q1a (type of wood-burning device), the pivot tables contained the appropriate number of rows for the allowed responses. In a number of pivot tables, a "blank" response row is also included. This applies to questions that were asked only of a subset of the entire 299-respondent sample because of the branching nature of the survey. This is illustrated below in Figure 4-2, which presents the tabulated responses for the different types of wood-burning devices used (Q1a). It shows a total of 195 "blank" records across all ZIP codes, reflecting the fact that 195 out of 299 households do not use a wood-burning device.

Figure 4-2
Pivot Cross-Tabulation of Q1a Responses

Q1A Wood Burning Type
(1-Fireplace, 2-FP w/insert, 3-Stove, 4-Outdoor Boiler, 5-DK, blank-not applicable)

Count	rzip						
q1a	99701	99703	99705	99709	99712	99775	Grand Total
1			3	3			6
2	1	1	1	3	1		7
3	12	4	25	38	10		89
4				1			1
5				1			1
	73	16	32	56	17	1	195
Grand Total	86	21	61	102	28	1	299

Appendix B contains the entire set of cross-tabulations of valid responses to each of the 71 questions in the 2010 survey. Within these tabulations presented in Appendix B, three tables are highlighted with shading. These tables were not pivot tables themselves but were calculated from results in other pivot tables in order to account for multiple heating devices being used within a single household. This element is described in more detail below.

Normalization to Account for Multiple Use Types – The next step in the analysis consisted of translating the cross-tabulated record counts into fractional or percentage distributions by device or fuel type so the survey results could be applied to update the emissions inventory. For example, a total of 103 out of 299 households were found to have some type of wood-burning device (with woodstoves the clear majority) across all ZIP codes, as shown above in Figure 4-2. This translates to 34.4% of surveyed households that burn wood.

As described earlier, the initial section of the survey asked respondents to identify all of the specific type(s) of heating devices used in the household. Thus the survey accounted for use of multiple heating devices within each household. These instances of multiple device use within a household had to be properly accounted for in tabulating the results to

ensure that surveyed usage is correctly extrapolated to the entire population of Fairbanks households.

Table 4-1 shows the multiple device usage factors that were calculated from the validated survey data.. In the first two rows of the table, the sample size is listed (presented both as household counts and percentages of all sampled households). The third row, labeled "Multi Type Household Factor," represents the ratio of the total number of devices used divided by the number of households. (For example, a factor of 2.0 would indicate an average of two devices in each household.) As seen in Table 4-1 (with the exception of the single household sample in the University area), there is a fairly consistent multi-type factor across all ZIP codes, with an average for the entire sample of 1.57. The last row in Table 4-1 shows the percentages of households by ZIP code that have more than one heating device. As shown, over 38% of all surveyed households use multiple heating devices.

Table 4-1
Sample Size and Multiple Use Types

	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Survey Sample	86	21	61	102	28	1	299
	28.8%	7.0%	20.4%	34.1%	9.4%	0.3%	100.0%
Multi-Type Household Factor	1.40	1.62	1.59	1.68	1.61	1.00	1.57
Multi-Type Household Use %	22.1%	42.9%	44.3%	48.0%	39.0%	0.0%	38.5%

[a] Also includes Birch Hill area

As noted earlier in Section 3.3, 11 household records that were not re-sampled were found with missing usage data, meaning that sections of the survey questions that should have been asked based on devices identified at the start of the survey were not. These records were preserved in the validated database to reflect the valid mix of devices used within each household. However, the remaining data in the device-specific sections of the survey database had to be treated as missing. This necessitated the tabulation of multiple-use household factors and use of these factors to properly normalize the data.

4.2 Survey Results

Device Counts and Usage Distributions – Table 4-2 summarizes the counts (number of households) of heating devices by device type and ZIP code from the survey sample. As seen in Table 4-2, central oil furnaces (247 total households) and wood-burning devices (108 total households) were the most commonly found home heating devices in the 299

household survey sample. The totals of all devices reported at the bottom of Table 4-2 reflect the fact that many households use more than one type of home heating device. These totaled counts, when divided by the number of households surveyed listed earlier in Table 4-1, match the Multi-Type Household Factors also reported in Table 4-1 (for example, within the Downtown area, 120 ÷ 86 = 1.42).

Table 4-2
Counts of Heating Device Types (Number of Surveyed Households with Device)

Heating Device Type	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Wood Burning	15	6	29	47	11	0	**108**
Central Oil Furnace	78	12	51	81	25	0	**247**
Portable Heat Device	2	1	3	4	1	0	**11**
Direct Vent Type	11	6	7	22	7	0	**53**
Natural Gas	5	4	1	5	0	1	**16**
Coal Heating	1	0	1	2	0	0	**4**
District Heating	2	4	1	0	0	0	**7**
Other	6	1	4	10	1	0	**22**
TOTALS	**120**	**34**	**97**	**171**	**45**	**1**	**468**

[a] Also includes Birch Hill area

Table 4-3 presents the distributions of device usage percentages by ZIP code during the winter months (October-March). These usage percentages were determined from the survey responses to Q9a-Q9h where the respondents are asked to estimate the percentage of time each household device is used during winter. The usage percentages in Table 4-3 are not based on either the counts of household devices or the amounts of fuel used queried in later sections of the survey. The usage percentages have been properly normalized to account for multiple device use within a household as described in the preceding sub-section. As shown in Table 4-3, central oil furnaces are used between 44% and 81% of the time in all ZIP code areas except University, with an average across the entire sample of 67.3%. Wood-burning devices represent 17.2% of total wintertime device usage across the entire sample, with higher percentages in the outlying areas (North Pole, Airport and Steese) than in those nearer the city center (Downtown, Wainwright and University). As seen in Table 4-3, households in the Wainwright/Birch Hill area have a much greater usage of District heating because of access to this underground infrastructure.

Table 4-3
Distributions of Respondent-Estimated Winter Heating Usage Percentages by Device Type

Heating Device Type	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Wood Burning	6.8%	9.8%	28.6%	20.1%	19.5%	0.0%	**17.2%**
Central Oil Furnace	80.8%	44.3%	63.2%	63.2%	69.6%	0.0%	**67.3%**
Portable Heat Device	0.1%	2.4%	0.0%	0.0%	0.0%	0.0%	**0.2%**
Direct Vent Type	7.0%	17.4%	3.5%	9.7%	10.5%	0.0%	**8.2%**
Natural Gas	4.7%	14.3%	1.6%	4.4%	0.0%	100.0%	**4.5%**
Coal Heating	0.0%	0.0%	0.1%	1.5%	0.0%	0.0%	**0.5%**
District Heating	0.6%	11.7%	1.6%	0.0%	0.0%	0.0%	**1.3%**
Other	0.1%	0.2%	1.2%	1.1%	0.4%	0.0%	**0.7%**

[a] Also includes Birch Hill area

Wood-Burning Device Breakdowns – As noted earlier, despite the fact that the survey indicates wood-burning devices are used less than 20% of the time, they are likely a significant contributor to wintertime ambient $PM_{2.5}$ levels. Table 4-4 lists the breakdowns in the types of wood-burning devices used within each surveyed ZIP code area. As shown, woodstoves represent an overwhelming majority of wood-burning device usage in Fairbanks. Over 86% of the wood burning according to the entire survey sample occurs using woodstoves. This is not surprising given their heating efficiency and the ability to locate the stove within the interior of a residence.

Table 4-4
Distribution of Wood-Burning Devices (Percent of Households Sampled)

Wood-Burning Device Type	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Fireplace	0.0%	0.0%	10.3%	6.7%	0.0%	0.0%	**5.8%**
Fireplace with Insert	7.7%	20.0%	3.4%	6.7%	9.1%	0.0%	**6.8%**
Woodstove	92.3%	80.0%	86.2%	84.4%	90.9%	0.0%	**86.4%**
Outdoor Wood Boiler	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	**1.0%**

[a] Also includes Birch Hill area

As also shown in Table 4-4, fireplaces represent most of the remaining wood-burning usage. Those with inserts constitute 6.8% of the overall sample. Fireplaces without inserts, which are extremely energy inefficient for space heating purposes, represent 5.8% of overall wood use. Outdoor boilers were found only in the Airport area and represent 1.0% of the entire surveyed sample.

Table 4-5 provides a further breakdown of the splits between un-certified and certified fireplace inserts or woodstoves. It shows that un-certified stoves/inserts represent about one-third (34.1%) of the overall sample, although the split varies significantly by ZIP code, possibly the result of small sample sizes for some of the ZIP codes.

Table 4-5
Splits Between Un-Certified and Certified Fireplace Inserts/Woodstoves
(Percent of Households Equipped)

Insert/Woodstove Certification Type	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Un-Certified (<1988)	16.7%	60.0%	46.2%	34.2%	10.0%	0.0%	**34.1%**
Certified (≥1988)	83.3%	40.0%	53.8%	65.8%	90.0%	0.0%	**65.9%**

[a] Also includes Birch Hill area

These splits were compiled based on the responses to Q10a of the survey: *"Was your woodstove or insert installed before or after 1988?"* Beginning in 1988, the U.S. EPA set mandatory smoke emission limits[*] for new woodstoves. Smoke emission levels of 1988 and newer stoves meeting these EPA limits are generally 50-80% lower than from older un-certified units, so the split between un-certified and certified stoves has a significant effect on particulate emissions.

Unlike the earlier 2006 and 2007 surveys, the 2010 survey also asked respondents who burn wood to estimate the amount of time they season (dry) their wood before using it, and to the extent possible, to estimate its moisture content. A total of 86 respondents provided estimates of their wood seasoning periods. The average seasoning period from these responses was 14.4 months and ranged from a minimum of zero months to a maximum of 48 months.

A much smaller number of wood-burning respondents, 16 households, provided quantitative estimates of the moisture content of their wood. The average moisture content from these responses was 7.9%. However, the accuracy of this estimate is suspect. First, the survey question did not explain how moisture content is defined, nor did it distinguish between representation on a dry or wet basis. Second, 5 of the 16 households responding with an estimate reported a moisture content of zero percent. Even using the typical practice of defining moisture content on a dry basis, a value of zero percent could be reached only if the wood was completely dried in an oven.

As noted earlier in Section 2, a separate study is concurrently being conducted by the CCHRC from a subset of the households polled in this survey to directly measure and more accurately represent wood moisture content.

[*] EPA certified woodstove smoke emission limits are 7.5 grams/hour and 4.1 grams/hour for non-catalytic and catalytic devices, respectively (http://www.epa.gov/burnwise/woodstoves.html)

Fuel Usage Rates and Costs - Table 4-6 summarizes average fuel usage rates (i.e., the amount of fuel used per season or year) and heating costs by device type for households equipped with or using each device/fuel. These usages are not to be confused with averages across all households.

Table 4-6
Wood Burning, Heating Oil and Other Fuel Usage Rates and Heating Costs per Equipped Household

Device Type & Fuel	Usage Period	Dntown 99701	Wnwrght[a] 99703	Nth Pole 99705	Airport 99709	Steese 99712	Univ 99775	**All**
Stove/Insert Wood Use (cords)	Annual	3.50	3.50	5.23	3.54	3.30	n/a	3.95
	Winter	3.10	3.25	4.71	3.28	2.70	n/a	3.60
Fireplace Wood Use (cords)	Annual	n/a	n/a	6.00	4.00	n/a	n/a	5.20
	Winter	n/a	n/a	5.67	3.00	n/a	n/a	4.60
Central Oil Use (gal)	Annual	1,258	1,083	996	1,141	1,053	n/a	1,135
	Winter	805	875	749	883	781	n/a	818
Portable Heater Fuel Use (gal)	Annual	n/a	n/a	20	2	300	n/a	107
	Winter	n/a	n/a	20	2	300	n/a	107
Direct Vent Heater Fuel Use (gal)	Annual	700	n/a	733	403	417	n/a	493
	Winter	625	n/a	633	311	417	n/a	444
Natural Gas Fuel Cost (dollars)	Annual	$1,950	$900	n/a	$2,717	n/a	No data	$2,159
	Winter	$1,700	$700	n/a	$1,180	n/a	No data	$1,260
District Heat Fuel Cost (dollars)	Annual	$2,800	$2,000	n/a	n/a	n/a	n/a	$2,400
	Winter	$1,500	$1,200	n/a	n/a	n/a	n/a	$1,350

[a] Also includes Birch Hill area
n/a – Not applicable (i.e., indicates where a device was not found in the sample for a specific ZIP code)

As shown in Table 4-6, households using either fireplaces with inserts or woodstoves burn an average of just under 4 cords annually and 3.60 cords of wood during winter months (October through March) across the entire survey sample. (These averages were compiled from a sample size of 96 households using fireplaces with inserts or woodstoves, consistent with the counts for responses "2" plus "3" in Figure 4-2.) As also shown in Table 4-6, households burning wood in fireplaces without inserts have higher average usage rates, using 5.20 and 4.60 cords annually and in winter, respectively. This is not surprising given the significantly lower net heating efficiency of standard fireplaces compared to those with inserts or woodstoves.

As reported in Table 4-6, households using central oil furnaces consume an average of 1,135 gallons of heating oil annually and 818 gallons during winter months alone. (These averages are based on a total of 247 central oil furnaces identified in the survey.)

Table 4-6 also lists similarly tabulated average fuel amounts or costs for portable/kerosene heaters, direct vent heaters, natural gas-based heating, and municipal heating. The sample sizes these device-specific averages were tabulated from were generally much smaller than for wood-burning and central heating devices. As such, they should be interpreted with caution.

Appendix C provides a complete list of the normalized survey results, tabulated by ZIP code. As noted above, average usage rates for these normalized tabulations are averaged over only those households equipped with the device for which usage is estimated, rather than all households in the survey sample.

Extrapolation of Survey Sample to Nonattainment Area – An important element of the analysis consisted of extrapolating heating device counts and usage rates from the sample of 299 surveyed households to the entire household population within the Fairbanks $PM_{2.5}$ nonattainment area. The extrapolation was based on the 2000 U.S. Census-based total households by ZIP code within the nonattainment area presented earlier in Table 2-1.

Extrapolation factors or multipliers were calculated from the number of households in an area (either an individual ZIP code or the entire area) from the Census data divided by the surveyed households for the same area. For example, the Downtown ZIP code (99701) area contains 7,164 households as listed earlier in Table 2-1. Since a total of 86 households within that ZIP code were surveyed as reported earlier in Table 4-1, the calculated extrapolation factor is 83.30 (7,164 ÷ 86).

Table 4-7 presents these extrapolated estimates of the number of heating devices by ZIP code area and across the entire Fairbanks $PM_{2.5}$ nonattainment area. The first row in the table lists the extrapolation factors calculated for each area to expand the survey sample to the entire population of households for each area. The remaining rows of the table present estimated counts of the number of devices by device type and ZIP code. The "short code" designations in the Device Type column of Table 4-7 identify each unique device type and clarify the sub-categories and sub-totals reported within the wood-burning sector.

The extrapolation of device counts from the survey sample to total households across the entire nonattainment area was performed two different ways: (1) by individual ZIP code and then summed; and (2) for the entire self-weighted sample. In Table 4-7, these total device counts for the nonattainment area are reported in the two rightmost columns labeled "ZIP Sum" and "Extrap," respectively. As seen in comparing these columns, the counts differ slightly. This is largely due to propagation of round-off error from small sample sizes within each ZIP code when summed across all ZIP code areas reflected in the survey sample. As a result, it is believed that the extrapolated counts using the entire self-weighted sample in the rightmost, shaded column are more accurate and should be used as best estimates of heating device counts within the $PM_{2.5}$ nonattainment area based on the 2010 survey data.

Table 4-7
Extrapolated Survey Heating Device Counts to $PM_{2.5}$ Nonattainment Area

Device Type	Dntown 99701	Wnwrt[a] 99703	Nth Pole 99705	Airport 99709	Steese 99712	Univ 99775	$PM_{2.5}$ NA Area ZIP Sum	$PM_{2.5}$ NA Area Extrap
Extrapolation Factor	*83.30*	*86.76*	*87.36*	*86.02*	*85.32*	*105.00*	*n/a*	*85.56*
1 - Wood-Burning Device	1,250	521	2,533	4,043	939	0	**9,285**	**9,241**
1a - Fireplace without insert	0	0	262	270	0	0	**532**	**538**
1b - Fireplace with insert	96	104	87	270	85	0	**642**	**628**
1c - Woodstove	1,153	416	2,184	3,414	853	0	**8,021**	**7,985**
Inserts & Woodstoves (1b+1c)	1,250	521	2,271	3,684	939	0	**8,664**	**8,613**
Stove/Insert, Uncertified	208	312	1,048	1,260	94	0	**2,923**	**2,934**
Stove/Insert, Certified	1,041	208	1,223	2,423	845	0	**5,741**	**5,679**
Stove/Insert Using Cord Wood	1,145	521	2,271	3,499	853	0	**8,290**	**8,246**
Stove/Insert Using Pellets	104	0	0	92	0	0	**196**	**366**
1d - Outdoor Wood Boiler	0	0	0	90	0	0	**90**	**90**
2 - Central Oil Furnace	6,498	1,041	4,455	6,968	2,133	0	**21,095**	**21,134**
3 - Portable Heater	167	87	262	344	85	0	**945**	**941**
4 - Direct Vent Heater	916	521	612	1,892	597	0	**4,538**	**4,535**
5 - Natural Gas Heating	417	347	87	430	0	105	**1,386**	**1,369**
6 - Coal Heat	83	0	87	172	0	0	**343**	**342**
7 - District Heat	167	347	87	0	0	0	**601**	**599**
8 - Other	500	87	349	860	85	0	**1,882**	**1,882**
All Heating Devices	9,996	2,950	8,474	14,709	3,839	105	**40,074**	**40,043**

[a] Also includes Birch Hill area

On this basis, a total of 9,241 wood-burning devices were estimated to be in use within the nonattainment area. Of these, 7,985 are free-standing woodstoves and 628 are fireplaces with inserts. From the combined total of 8,613 stoves/inserts, 2,934 are estimated to be un-certified (pre-1988). Fireplaces without inserts and outdoor wood boilers represent the remaining wood-burning devices; their counts within the nonattainment area are 538 and 90, respectively, as shown in Table 4-7. As explained earlier in Section 1, the precision of device count estimates are not necessarily accurate to the whole integer values listed in Table 4-7. The whole integer values are simply shown in this table to illustrate how they were calculated from the sample-to-nonattainment area extrapolation factors.

Statistical Uncertainty Analysis – In extrapolating devices counted in the 299 household survey sample to the entire nonattainment area, an additional issue that was addressed was the resulting statistical uncertainty. As reported earlier in Figure 4-2 and Table 4-2, only one outdoor wood boiler and four coal heaters were found in the 299 household

sample. Thus, an analysis of the uncertainties associated with proportional extrapolation of the household sample to the entire nonattainment area was performed.

The results of this uncertainty analysis are presented in the next three tables. The estimates in these tables quantify the statistical uncertainty associated with extrapolating the device usage distributions in the surveyed sample represented earlier in Tables 4-3 through 4-5 to all the households in the nonattainment area. In each of these tables, the standard error of proportion was used as the measure of statistical uncertainty. It represents the accuracy of each proportional (i.e., usage fraction) estimate in the sample, measured as the standard deviation of that proportion.

First, Table 4-8 presents standard errors of proportion associated with the respondent-estimated usage fractions of each major device type reported earlier in Table 4-3. The first value in each cell is the usage fraction from Table 4-3; the second value represents one standard deviation of this usage fraction. For example, the fraction of wood-burning devices used in winter for the entire sample was 17.2% (as listed earlier in Table 4-3). Assuming device usage is normally distributed, the value of ±2.2% listed in the upper right cell in Table 4-8 means that the actual wood-burning usage fraction lies between 15.0% (17.2 - 2.2) and 19.4% (17.2 + 2.2) with 68% probability.*

Table 4-8
Standard Error of Proportion for
Respondent-Estimated Winter Heating Usage Percentages by Device Type

Heating Device Type	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Wood Burning	6.8% ±2.7%	9.8% ±6.5%	28.6% ±5.8%	20.1% ±4.0%	19.5% ±7.5%	n/a	**17.2% ±2.2%**
Central Oil Furnace	80.8% ±4.2%	44.3% ±10.8%	63.2% ±6.2%	63.2% ±4.8%	69.6% ±8.7%	n/a	**67.3% ±2.7%**
Portable Heat Device	0.1% ±0.3%	2.4% ±3.3%	n/a	n/a	n/a	n/a	**0.2% ±0.3%**
Direct Vent Type	7.0% ±2.8%	17.4% ±8.3%	3.5% ±2.4%	9.7% ±2.9%	10.5% ±5.8%	n/a	**8.2% ±1.6%**
Natural Gas	4.7% ±2.3%	14.3% ±7.6%	1.6% ±1.6%	4.4% ±2.0%	n/a	Insufficient data	**4.5% ±1.2%**
Coal Heating	n/a	n/a	0.1% ±0.4%	1.5% ±1.2%	n/a	n/a	**0.5% ±0.4%**
District Heating	0.6% ±0.8%	11.7% ±7.0%	1.6% ±1.6%	n/a	n/a	n/a	**1.3% ±0.7%**
Other	0.1% ±0.3%	0.2% ±1.0%	1.2% ±1.4%	1.1% ±1.0%	0.4% ±1.2%	n/a	**0.7% ±0.5%**

[a] Also includes Birch Hill area
n/a – Not available

* 68% probability represents the probability of a normally-distributed sample within one standard deviation of its mean.

As expected, the usage fraction estimates within individual ZIP code areas have wider ranges of standard error than the overall estimate across all areas because the standard error estimates are related to sample size. As seen in the rightmost column in Table 4-8, the standard errors for heating device usage fraction are less than ±3% across the entire nonattainment area.

Similarly, Tables 4-9 and 4-10 present Standard Error of Proportion estimates for proportional device usage within the wood-burning sector and between un-certified and certified woodstoves/inserts, respectively.

Table 4-9
Standard Error of Proportion for
Distribution of Wood-Burning Devices (Percent of Households Sampled)

Wood-Burning Device Type	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Fireplace	n/a	n/a	10.3% ±3.9%	6.7% ±2.5%	n/a	n/a	**5.8% ±1.4%**
Fireplace with Insert	7.7% ±2.9%	20.0% ±8.7%	3.4% ±2.3%	6.7% ±2.5%	9.1% ±5.4%	n/a	**6.8% ±1.5%**
Woodstove	92.3% ±2.9%	80.0% ±8.7%	86.2% ±4.4%	84.4% ±3.6%	90.9% ±5.4%	n/a	**86.4% ±2.0%**
Outdoor Wood Boiler	n/a	n/a	n/a	2.2% ±1.5%	n/a	n/a	**1.0% ±0.6%**

[a] Also includes Birch Hill area
n/a – Not available.

Table 4-10
Standard Error of Proportion for
Un-Certified and Certified Stove/Insert Splits (Percent of Households Equipped)

Insert/Woodstove Certification Type	Downtown 99701	Wainwright[a] 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	**All**
Un-Certified (<1988)	16.7% ±4.0%	60.0% ±10.7%	46.2% ±6.4%	34.2% ±4.7%	10.0% ±5.7%	n/a	**34.1% ±4.2%**
Certified (≥1988)	83.3% ±4.0%	40.0% ±10.7%	53.8% ±6.4%	65.8% ±4.7%	90.0% ±5.7%	n/a	**65.9% ±8.0%**

[a] Also includes Birch Hill area
n/a – Not available.

Translation of Results to All-Household Inventory Basis – Table 4-11 presents estimates of key fuel usage rates on a per-household basis across all households within the nonattainment area, irrespective of whether an individual household uses that fuel.

Table 4-11
Wood Burning, Heating Oil and Other Fuel Usage Rates and Heating Costs per Household (Any Household)

Device Type & Fuel	Usage Period	Dntown 99701	Wnwrght[a] 99703	Nth Pole 99705	Airport 99709	Steese 99712	Univ 99775	**All**
Stove/Insert Wood Use (cords)	Annual	0.53	0.83	2.23	1.42	1.30	n/a	**1.27**
	Winter	0.47	0.77	2.01	1.32	1.06	n/a	**1.15**
Fireplace Wood Use (cords)	Annual	n/a	n/a	0.30	0.12	n/a	n/a	**0.10**
	Winter	n/a	n/a	0.28	0.09	n/a	n/a	**0.09**
Central Oil Use (gal)	Annual	1,141	619	833	906	940	n/a	**938**
	Winter	730	500	626	701	697	n/a	**676**
Portable Heater Fuel Use (gal)	Annual	n/a	n/a	0.98	0.08	10.71	n/a	**3.95**
	Winter	n/a	n/a	0.98	0.08	10.71	n/a	**3.95**
Direct Vent Heater Fuel Use (gal)	Annual	90	n/a	84	87	104	n/a	**87**
	Winter	80	n/a	73	67	104	n/a	**79**
Natural Gas Fuel Cost (dollars)	Annual	$113	$171	n/a	$133	n/a	No data	**$116**
	Winter	$99	$133	n/a	$58	n/a	No data	**$67**
District Heat Fuel Cost (dollars)	Annual	$65	$381	n/a	n/a	n/a	n/a	**$56**
	Winter	$35	$229	n/a	n/a	n/a	n/a	**$32**

[a] Also includes Birch Hill area
n/a – Not applicable (i.e., indicates where a device was not found in the sample for a specific ZIP code)

The fuel usage rates per equipped household reported earlier in Table 4-6 were converted to this all-household basis in Table 4-11 for easier use in generating emission inventory estimates for residential space heating sources within the nonattainment area. As a result, the fuel usage and cost estimates (on an any-household basis) are significantly lower than those in Table 4-6 based on equipped households. For use in estimating emissions, the fuel usage rates per household (per season or annually) would simply be multiplied by the number of households in a given area (e.g., ZIP code or grid cell) and combined with device/fuel type-specific emission rates.

Comparisons Across Surveys – Finally, Table 4-12 presents a comparison of key tabulations from each of the three separate Fairbanks Home Heating surveys: 2006, 2007, and the current 2010 survey. As explained earlier, the tabulations from the earlier surveys were re-weighted by ZIP code using the same weightings on which the 2010 survey was based for consistency when compared with the 2010 results. Highlighted cells in Table 4-12 identify key metrics where significant changes were observed in the 2010 survey compared to the earlier surveys.

Table 4-12
Summary of Key Results from 2006, 2007 and 2010 Home Heating Surveys

Statistic	Parameter	Survey Results		
		2006[a]	2007[a]	2010
Average Winter Device Use by Type (% of Household Use)	Wood	**10.1%**	**11.8%**	**17.2%**
	Central Oil	68.0%	63.6%	67.3%
	Portable	0.7%	0.5%	0.2%
	Direct Vent	8.6%	7.4%	8.2%
	Natural Gas	2.6%	2.3%	4.5%
	Coal Heat	n/a	n/a	0.5%
	District Heat	2.8%	1.1%	1.3%
	Other	7.2%	13.4%	0.7%
Wood Burning Type (% of Wood-Burning Devices)	Fireplace	**13.0%**	**17.5%**	**5.8%**
	Fireplace + Insert	8.3%	5.6%	6.8%
	Woodstove	**78.8%**	**76.9%**	**86.4%**
	Wood Boiler	n/a	n/a	1.0%
Wood Stove/Insert Cert Type (% of Woodstoves/Inserts)	<1988 (Un-Certified)	**52.4%**	**46.8%**	**34.1%**
	≥1988 (Certified)	**47.6%**	**53.2%**	**65.9%**
Stove/Insert Wood Use (cords), Winter	Winter Season	**2.87**	**2.85**	**3.60**
Fireplace Wood Use (cords), Winter	Winter Season	**0.76**	**0.74**	**4.60**
Central Oil Use (gallons), Winter	Winter Season	**1,099**	**1,011**	**818**
Portable Heater Fuel Use (gallons), Winter	Winter Season	91.7	152.7	107.3
Direct Vent Heater Fuel Use (gallons), Winter	Winter Season	296	472	444
Natural Gas Heating Fuel Cost (dollars), Winter	Winter Season	**$553**	**$947**	**$1,260**
Municipal Heating Fuel Cost (dollars), Winter	Winter Season	n/a	n/a	$1,350

[a] Winter usage in these surveys encompassed October-May; 2010 winter usage spanned October-March.

First, the overall percentage of wintertime wood-burning device use increased to over 17% in the 2010 sample (over usage fractions of 10-12% in the earlier surveys). In addition, the distribution of wood-burning devices used has changed: no-insert fireplace use is lower in the 2010 sample (5.8%), while woodstove use is higher (86.4%).

Within the populations of woodstoves and fireplaces with inserts in the survey samples, the fraction of un-certified stoves/inserts has dropped markedly from 52.4% in 2006 to 34.1% in 2010. On the other hand, winter wood usage (i.e., the amount burned per wood-burning household) has increased noticeably for both stoves/inserts and no-insert fireplaces. (As discussed earlier, the variations observed for the no-insert fireplaces may be related to small sample sizes.)

Beyond the wood-burning sector, Table 4-12 also highlights a clear reduction in the wintertime central oil use. Although the usage fraction for central oil furnaces (the respondent-estimated fraction of use within the household) had remained fairly steady, between 63.9% and 68.0% as reported in the upper section of Table 4-12, usage amounts (gallons of fuel oil) per household dropped nearly 20% in the 2010 sample (818 gallons) compared to the earlier surveys.

To understand the possible causes of this decrease in central oil usage, an analysis of wintertime Fairbanks heating degree days[*] was conducted. Comparisons of degree days during the same six-month winter periods of each survey indicated that ambient temperature-based heating demand in 2010 was roughly 94% of the winter average of 2006 and 2007. Therefore, most of the 20% decrease in central oil usage seen in the 2010 survey was not the result of year-to-year ambient temperature variations. The other likely explanations for this decrease are either: 1) participation in the recently-initiated Alaska Home Energy Rebate Program[†]; or 2) a shift to other devices/fuels resulting from market prices of heating oil. (An analysis of the effects of participation in the Home Energy Rebate Program was beyond the scope of this study.)

A significant increase in wintertime natural gas heating costs per equipped household is also highlighted in Table 4-12. Costs per household have more than doubled from $553 in 2006 to $1,260 in 2010. Whether this reflects a greater usage of natural gas heating is unclear; no analysis of changes in residential natural gas heating prices over this four-year period was performed. However, as also reported in Table 4-12, respondent-estimated usage fraction for natural gas heating increased from 2.6% in 2006 to 4.5% in 2010.

As footnoted in Table 4-12, one element that was not fully consistent across the three surveys was the definition of winter season activity. For the 2006 and 2007 surveys, winter was defined as October through May; as noted earlier, the 2010 survey defined winter as October through March. Rather than try to adjust[‡] the results data from the earlier surveys downward to reflect the shorter winter period in the 2010 survey, this difference is simply noted. Thus, the higher winter season usage seen in the 2010 survey would be further magnified if a seasonal adjustment were made.

###

[*] Calculated 65°F heating degree days at Fairbanks International Airport (PAFA), www.degreedays.net

[†] Alaska Housing Finance Corporation, http://www.akrebate.com/rebate_about.aspx

[‡] Given the strong relationship between ambient temperature and residential heating demand/activity, it is not appropriate to simply adjust the 2006 and 2007 usage data by the difference in winter periods across the three surveys (i.e., by a factor of 6/8 months.) because historical April-May ambient temperatures tend to be much warmer than the average from October-March.

APPENDIX A

2010 Home Heating Survey Questionnaire

hays research group

Fairbanks Heating Survey
Draft G

Phone # _____ Survey # _____
Interviewer Name _____
Date _____

(Location of Home)

Good evening, I am calling from Hays Research Group; we are conducting a brief survey on behalf of the Fairbanks Northstar Borough (BURR-oh) regarding home space heating options. May I please speak to the person most knowledgeable about the heating devices in your home? **(IF NOT AVAILABLE – When would be the best time to reach him/her? Set a callback and get a name.)**

Q1-Q8) Please tell me which of the following devices provide space heat for your home?

Q1) A wood burning device?

1. Yes
2. No
3. DK/REF

Q2) A central Oil furnace?

1. Yes
2. No
3. DK/REF

Q3) Portable Fuel Oil/Kerosene heating device?

1. Yes
2. No
3. DK/REF

Q4) Toyo (TOY-oh), Monitor or other direct vent type heater?

1. Yes
2. No
3. DK/REF

Q5) Natural Gas Heat?

1. Yes
2. No
3. DK/REF

Q6) Coal Heat

1. Yes
2. No
3. DK/REF

Q7) Municipal Heat?

1. Yes
2. No
3. DK/REF

Q8) Other not listed? _____

QQ) And can you please tell me how many square feet are in your home, not including any garage space?

1. _____sq. ft.
2. DK/REF

(At least one of the questions between Q1-Q7 must = 1 yes, otherwise terminate)

(Ask Q1a if Q1=1, otherwise skip to Q9)

Q1a) Is your wood burning device a fireplace, a fireplace with insert, a wood burning stove or outdoor wood boiler?

1-Fireplace
2-Fireplace with insert
3-Wood burning stove
4-Outdoor Wood Boiler (note could called hydronic heater by some)
5-DK/REF

Q9) **(Q9 answers must total 100%)** What percentage of your heating is done by each of the following devices during the winter months, from October to March?

a. Wood Burning Device	%
b. Central Oil furnace	%
c. Portable Fuel Oil/Kerosene	%
d. Direct Vent type	%
e. Natural Gas Heat	%
f. Coal Heat	%
g. Municipal Heat	%
h. Other	%

We'll now get into some usage details of each type of heating.

(Section 1: Wood burning stove/Fireplace insert)

(Ask Q10-Q12 if Q1a = 2) "Fireplace with insert" or 3) "Wood burning stove", otherwise skip to Q13)

Q10a) Was your wood burning stove or insert installed before or after 1988?

1) Before
2) After
3) DK/REF

Q11a) How old is your wood burning stove or insert? Allow multiple responses

1) Less than 1 year
2) 1-5
3) 5-10
4) 10-15
5) 15+ years
6) DK/REF

Q11b) Is your wood stove or insert catalytic or non –catalytic?

1) catalytic
2) non-catalytic
3) DK/REF

Q12) Does your stove or insert burn pellets or cord wood? Allow multiple responses

1)Pellets
2)Cord Wood
3) DK/REF

(Ask Q13-Q14 if Q12=2 "Cord wood", otherwise skip to Q15)

Q13) What best describes your use of wood heat during the winter months, October to March?

a. Day time only	d. Weekend only	g. Not currently using any device
b. Evening only	e. Evening and Weekend only	h. Don't know (do not read)
c. Daytime and evening	f. Occasional use	i. Refused (do not read)

Q14) Where do you get the wood for your heating? Allow multiple responses

1. Buy wood
2. Cut your own
3. DK/REF

(Ask Q15-Q17a if Q14=2 "Cut your own", otherwise skip to Q18)

Q15) When cutting wood do you get a permit?

1. Yes
2. No
3. DK/REF

Q16) How many months do you season your wood before burning it?

1._____Months
2. DK/REF=9999

Q17) Do you know what the moisture content of your wood is, and if so, what is it?

1._____Percent
2. DK/REF=9999

(Ask Q18-Q19 if Q12 =2 "Cord wood", otherwise skip to Q20)

18) In cords, how much wood do you burn in your wood burning stove or insert annually? (If the respondent asks, one cord of wood is four feet wide, four feet high, and eight feet long stacked)

1. Wood in cords _____
2. DK/REF=9999

Q19) In cords, how much do you burn from October to March?

1. Wood in cords _____
2. DK/REF=9999

(Ask Q20-Q21 if Q12=1 "pellets", otherwise skip to Q22)

Q20) How many 40 lb bags of pellets do you burn in your wood burning stove or insert annually?

1. 40 lb bags of pellets _____
2. DK/refused=9999

Q21) How many bags do you burn from October to March?

1. 40 lb bags of pellets _____
2. DK/refused=9999

(Ask Q22 if q18 or q19= DK/REF, otherwise skip to Q23)

Q22) How much do you spend per year on wood?

1. $_____
2. DK/refused=9999

(Ask q23 if q20 or q21 = DK/REF, otherwise skip to Q24)

Q23) How much do you spend per year on pellets?

1. $_____
2. DK/refused=9999

(Section 2: Wood burning Fireplace)

(Ask Q24-Q25 if Q1a = 1 "Fireplace", otherwise skip to Q32)

Q24) From this list, what best describes your use of wood heat during the winter months, from October to March?

a. Day time only	d. Weekend only	g. Not currently using any device
b. Evening only	e. Evening and Weekend only	h. Don't know (do not read)
c. Daytime and evening	f. Occasional use	i. Refused (do not read)

Q25) Where do you get the wood for your heating? (Allow multiple responses)

1. Buy wood
2. Cut your own
3. DK/REF

(Ask Q26-Q31 if Q25=2, otherwise skip to Q32)

Q26) When cutting wood do you get a permit?

1. Yes
2. No
3. DK/REF

Q27) How many months do you season your wood before burning it?

1. Months _____
2. DK/refused=9999

Q28) Do you know what the moisture content of your wood is, and if so, what is it?

1. Percent _____
2. DK/refused=9999

Q29) In cords, how much wood do you burn in your fireplace annually?

1. _____cords
2. DK/refused = 9999

Q30) How much do you burn from October to March?

1. _____cords
2. DK/REF=9999

Q31 How much do you spend per year on wood?

1. $_____
2. DK/REF=9999

(Section 3: Outdoor Wood Boiler)

(Ask Q32-Q33 if section if Q1a = 4 "outdoor wood boiler", otherwise skip to Q34)

Q32) What best describes your use of wood heat during the winter months, from October to March?

a. Day time only	d. Weekend only	g. Not currently using any device
b. Evening only	e. Evening and Weekend only	h. Don't know (do not read)
c. Daytime and evening	f. Occasional use	i. Refused (do not read)

Q33) Where do you get the wood for your heating? (allow multiple responses)

1. Buy wood
2. Cut your own
3. DK/REF

(Ask Q34-Q36 if Q33=2 "cut your own", otherwise skip to Q37)

Q34) When cutting wood do you get a permit?

1. Yes
2. No
3. DK/REF

Q35) How many months do you season your wood before burning it?

1. Months _____
2. DK/REF=9999

Q36) Do you know what the moisture content of your wood is, and if so, what is it?

1. Percent _____
2. DK/REF=9999

Q37) In cords, how much wood do you burn in your outdoor wood boiler annually?

1. _____cords
2. DK/REF=9999

Q38) How much do you burn from October to March?

1. _____cords
2. REF=9999

(ask Q39 if Q33= 1 "Buy wood", otherwise skip to Q40)

Q39) How much do you spend per year on wood?

1. $_____
2. DK/REF=9999

Q40) What is the brand name of your outdoor wood boiler? (open ended)

(Section 4: Central Oil)

(ask Q41-Q44 of Q2=1 "yes", otherwise skip to Q45)

Q41) How large is your fuel oil tank, in gallons?

1. _____Gallons
2. DK/REF=9999

Q42) In gallons, how much oil do you use annually?

1. _____Gallons
2. DK/REF=9999

Q43) How many gallons do you use during the winter months (October – March)?

1. _____Gallons
2. DK/REF=9999

Q44) How much do you spend per year on fuel oil?

1. $_____
2. 9999=No/DK/REF

(Section 5: Portable Fuel Oil/Kerosene Heating Device)

(Ask Q45-Q46 if Q3=1 "YES", otherwise skip to Q47)

Q45) You mentioned using a Portable Fuel Oil or Kerosene Heating Device, does the device use Fuel Oil?

1. Yes
2. No
3. DK/REF

Q46) Does the device use Kerosene?

1. Yes
2. No
3. DK/REF

(If Q45 OR Q46 = 1 "yes", read Q47-Q48, otherwise skip to Q49)

Q47) In gallons, how much oil/kerosene do you use annually?

1. _____gallons
2. DK/REF=9999

Q48) How many gallons do you use during the winter months (October – March)?

1. _____gallons
2. DK/REF=9999

Q49) How much do you spend per year on oil/kerosene? No/DK/REF=9999

1. $_____
2. DK/REF=9999

(Section 5.1
For homes using Central Oil, and/or Portable Fuel Oil/Kerosene Heating Devices, and/or Other devices)

(Ask Q50 if Q2=1 "yes" or Q3=1 "yes" or Q7=1 "yes", otherwise skip to Q51

Q50) From this list please tell me what best describes your use of fuel oil and kerosene burning devices during the winter months, from October to March?

a. Day time only	d. Weekend only	h. Not currently using any device
b. Evening only	e. Evening and Weekend only	j. Don't know (do not read)
c. Daytime and evening	f. Occasional use	i. Refused (do not read)

Section 6: Toyo, Monitor, or other Direct Vent Type of Heater if uses fuel oil and direct vent fuel consumption question

(Ask this section if Q4=1 "yes", otherwise skip to Q55)

If Q2=1 and Q4=1 skip Q 51 & Q52

Q51) In gallons, how much oil do you use annually?

1. _____Gallons
2. 9999=DK/refused

Q52) How many gallons do you use during the winter months (October – March)?

1. _____Gallons
2. 9999=DK/REF

Q53) How much do you spend per year on oil?

1. $_____
2. 9999=DK/REF

Q54) What best describes your use of direct vent heating device during the winter months, from October to May?

a. Day time only	d. Weekend only	h. Not currently using any device

b. Evening only	e. Evening and Weekend only	j. Don't know (do not read)
c. Daytime and evening	f. Occasional use	i. Refused (do not read)

Section 7: Natural Gas Heating Device

(if Q5=1 "yes", ask Q55-Q56, otherwise skip to Q57)

Q55) How much do you spend on natural gas annually?

1. $_____
2. DK/REF=9999

Q56) How much do you spend during the winter months, from October to March?

1. $_____
2. DK/REF=9999

Section X: Coal Heating Device

(if q6=1 "yes", ask Q57-Q60, otherwise skip to Q61)

Q57) How much coal do you use annually?

1. __tons
2. __bags
3. DK/refused

Q58) How much did you pay for the coal?

1. ___$/bag
2. ___$/ton
3. DK/refused

Q59) How much coal do you use during the winter (October – March)?

1. __tons
2. __bags
3. DK/refused

Q60) Is your coal burned in an indoor stove or an outdoor boiler?

1. Indoor stove
2. Outdoor boiler
3. DK/refused

(Section F: Municipal Heat)

If Q7=1 "yes", ask Q61-Q62, otherwise skip to Q63)

Q61) How much do you spend on municipal heat annually?

1. $_____
DK/refused =9999

Q62) How much do you spend on municipal heat during the winter months, October to March?

1. $_____
DK/REF=9999

Future Section (to be completed for every survey)

Q63) Do you anticipate acquiring a new or different type of heating device within the next 2 years?

1. Yes
2. No
3. DK/refused

(If Q63=1 "yes", ask Q64, otherwise skip to

Q64) What type of device do you plan to acquire? READ LIST

a. Wood Stove	d. Fuel Oil		h. Don't know (do not read)
b. Wood Pellet	e. Kerosene		i. Refused (do not read)
c. Outdoor Wood Boiler	f. Coal stove	g. Outdoor coal boiler	j Other (Specify)

(If Q64= a. 'Wood stove", ask Q64a, otherwise skip to Q65)

Q64a) Newer EPA certified stoves are more efficient and require less chimney cleaning than older stoves. These benefits ultimately offset the purchase price, particularly if you hire chimney sweepers. How quickly would a new stove need to pay for itself in order for you to buy one?

1. 1 year
2. 2 years
3. 3 years
4. 4 years
5. 5 years or more
6. None
7. Don't Know/Refused (do not read)

Q64b) Would you invest in a new more efficient stove if you were to receive a price incentive paid by either state or local government of $250? (like a rebate)

1. Yes
2. No → ask 64c

if answer to 64 b is no then proceed to 64c:
Q64c) What if the price incentive was $500?

1. Yes
2. No → ask 64d

if answer to 64 c is no then proceed to 64 d:
Q64d) And if the price incentive were $750, would you invest in a new stove?

1. Yes
2. No → ask 64e

if answer to 64 d is no then proceed to 64 e:
Q64e) What if the incentive were $1,000?

1. Yes
2. No → ask 64f

if answer to 64e) is no then proceed to 64f)
Q64F How much of an incentive would it take for you to invest in a new stove?

1. $1000 – 1200
2. $1201 – 1500
3. $1501 – 1750
4. $1751 – 2000
5. $2001 or more
6. DK/refused

(If Q1a=1 or Q12=2 ask Q65-Q68, otherwise skip to Q69)
Q65) Did you burn more wood this winter to minimize the cost of heating oil?

1. Yes
2. No
3. DK/REF

Q66) What fuel oil price would cause you to shift away from using wood for heating?
(If respondent is unclear of question ask: If fuel oil prices decline, at what price will you shift to using more fuel oil to heat and decrease the use of wood?)

Specify:_____

Q67) The Borough has contracted with the Cold Climate Housing Research Center (CCHRC) to conduct a study to monitor wood and heating oil used for home heating in Fairbanks during the winter. Data would be collected for a month and there is a $100 incentive for participating. Would you be interested in participating?

1. Yes
2. No
3. DK/REF

Q68) The Borough has also contracted with CCHRC to determine the moisture content of wood used in heating homes in Fairbanks. CCHRC will obtain a sample of wood supplies from fifty

homes. Each homeowner will be provided with an equal amount of properly dried wood to replace the sample taken (approximately 10 pieces per household). Would you be interested in participating in this study by allowing us to come to your home and collect about ten pieces of firewood?

1. Yes
2. No
3. DK/REF

(ASK Q69 ONLY IF ZIP=99709, otherwise skip to Q70)

Q69) Can you please tell me whether you live inside of Chena Ridge (to the east of the ridge) or outside of Chena Ridge (to the west of the ridge).

1. Inside Chena Ridge
2. Outside Chena Ridge
3. DK/REF

(ASK Q70 ONLY IF ZIP=99712, otherwise skip to closing statement)

Q70) Can you please tell me if you live inside of Farmers Loop Road or outside of Farmers Loop Road?

1. Inside Farmers Loop Road
2. Outside Farmers Loop Road
3. DK/REF

(ASK ALL)

Q71) How do you keep abreast of current issues is it (read list, allow more than one answer)

1. TV
2. Radio
3. Newspaper
4. Internet
5. Other
6. DK/refused

Thank you, that is all the questions I have this evening. If you have questions or comments about this survey, I can give you the contact information for Hays Research Group. Again, thank you for your time. **(contact information for Hays Research Group is heatsurvey@haysresearch.com NOTE NO 'E' in HAYS, or (907) 277-1025)**

APPENDIX B

2010 Fairbanks Home Heating Survey Tabulated Responses

Section 0: Heating Devices Used and Usage Percentages

Q1 Heating Type - Wood Burning (1-Yes, 2-No, 3-DK)

Count	rzip						
q1	99701	99703	99705	99709	99712	99775	Grand Total
1	15	6	29	47	11		108
2	71	15	32	55	17	1	191
3							
Grand Total	86	21	61	102	28	1	299

Q2 Heating Type - Central Oil Furnace (1-Yes, 2-No, 3-DK)

Count	rzip						
q2	99701	99703	99705	99709	99712	99775	Grand Total
1	78	12	51	81	25		247
2	8	9	10	21	3	1	52
3							
Grand Total	86	21	61	102	28	1	299

Q3 Heating Type - Portable Heater (1-Yes, 2-No, 3-DK)

Count	rzip						
q3	99701	99703	99705	99709	99712	99775	Grand Total
1	2	1	3	4	1		11
2	84	20	58	97	27	1	287
3				1			1
Grand Total	86	21	61	102	28	1	299

Q4 Heating Type - Direct Vent Heater (1-Yes, 2-No, 3-DK)

Count	rzip						
q4	99701	99703	99705	99709	99712	99775	Grand Total
1	11	6	7	22	7		53
2	74	14	54	77	21	1	241
3	1	1		3			5
Grand Total	86	21	61	102	28	1	299

Q5 Heating Type - Natural Gas Heating (1-Yes, 2-No, 3-DK)

Count	rzip						
q5	99701	99703	99705	99709	99712	99775	Grand Total
1	5	4	1	5		1	16
2	80	17	60	97	28		282
3	1						1
Grand Total	86	21	61	102	28	1	299

Q6 Heating Type - Coal Heat (1-Yes, 2-No, 3-DK)

Count	rzip						
q6	99701	99703	99705	99709	99712	99775	Grand Total
1	1		1	2			4
2	85	21	60	100	28	1	295
Grand Total	86	21	61	102	28	1	299

Q7 Heating Type - Municipal Heat (1-Yes, 2-No, 3-DK)

Count	rzip						
q7	99701	99703	99705	99709	99712	99775	Grand Total
1	2	4	1				7
2	79	15	59	100	27	1	281
3	5	2	1	2	1		11
Grand Total	86	21	61	102	28	1	299

Q8 Heating Type - Other Not Listed (1-Yes, 2-No, 3-DK)

Count	rzip						
q8	99701	99703	99705	99709	99712	99775	Grand Total
1	6	1	4	10	1		22
2	79	18	57	90	27	1	272
3	1	2		2			5
Grand Total	86	21	61	102	28	1	299

Counts of Devices Used by Type and ZIP Code

Device Type	99701	99703	99705	Res ZIP 99709	99712	99775	All
1 - Wood-Burning	15	6	29	47	11	0	**108**
2 - Central Oil Furnace	78	12	51	81	25	0	**247**
3 - Portable Heater	2	1	3	4	1	0	**11**
4 - Direct Vent Heater	11	6	7	22	7	0	**53**
5 - Natural Gas Heating	5	4	1	5	0	1	**16**
6 - Coal Heat	1	0	1	2	0	0	**4**
7 - Municipal Heat	2	4	1	0	0	0	**7**
8 - Other	6	1	4	10	1	0	**22**
Total	**120**	**34**	**97**	**171**	**45**	**1**	**468**

Multi-Use Households

Item	99701	99703	99705	Res ZIP 99709	99712	99775	All
1 thru 7	114	33	93	161	44	1	446
1 thru 8	120	34	97	171	45	1	468
Total HHs	86	21	61	102	28	1	299
% Mult Type	**40%**	**62%**	**59%**	**68%**	**61%**	**0%**	**57%**

QQ Home Area - Square Feet

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	1,770	1,663	2,142	2,084	2,091		1,988

Q1A Wood Burning Type
(1-Fireplace, 2-FP w/insert, 3-Stove, 4-Outdoor Boiler, 5-DK, blank-Not Applicable)

Count	rzip						
q1a	99701	99703	99705	99709	99712	99775	Grand Total
1			3	3			6
2	1	1	1	3	1		7
3	12	4	25	38	10		89
4				1			1
5				1			1
	73	16	32	56	17	1	195
Grand Total	86	21	61	102	28	1	299

Q9 Winter (Oct-March) Use Percentage by Type (Sum)

	rzip						
Data	99701	99703	99705	99709	99712	99775	Grand Total
Wtr Wood Burning	585	205	1745	2052	545	0	5132
Wtr Central Oil	6945	930	3857	6450	1950	0	20132
Wtr Portable	10	50	2	0	0	0	62
Wtr Direct Vent	600	365	215	990	295	0	2465
Natural Gas	400	300	100	445	0	100	1345
Wtr Coal Heat	0	0	5	150	0	0	155
Wtr Municipal Heat	50	245	100	0	0	0	395
Wtr Other Types	10	5	76	113	10	0	214

Q9 Winter (Oct-March) Use Responses by Type

Count	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	86	21	61	102	28	1	299

Q9 Winter (Oct-March) Average Use Percentage by Type

Data	99701	99703	99705	Res ZIP 99709	99712	99775	Grand Total
Wtr Wood Burning	6.8%	9.8%	28.6%	20.1%	19.5%	0.0%	17.2%
Wtr Central Oil	80.8%	44.3%	63.2%	63.2%	69.6%	0.0%	67.3%
Wtr Portable	0.1%	2.4%	0.0%	0.0%	0.0%	0.0%	0.2%
Wtr Direct Vent	7.0%	17.4%	3.5%	9.7%	10.5%	0.0%	8.2%
Natural Gas	4.7%	14.3%	1.6%	4.4%	0.0%	100.0%	4.5%
Wtr Coal Heat	0.0%	0.0%	0.1%	1.5%	0.0%	0.0%	0.5%
Wtr Municipal Heat	0.6%	11.7%	1.6%	0.0%	0.0%	0.0%	1.3%
Wtr Other Types	0.1%	0.2%	1.2%	1.1%	0.4%	0.0%	0.7%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Section 1: Wood-Burning Stove or Fireplace with Insert

Q10A Wood Stove/Insert Age (1-: <1988, 2: >1988, 3-DK, blank-Not Applicable)

Count	rzip						
q10a	99701	99703	99705	99709	99712	99775	Grand Total
1	2	3	12	13	1		31
2	10	2	14	25	9		60
3	1			3	1		5
	73	16	35	61	17	1	203
Grand Total	86	21	61	102	28	1	299

Q11A Wood Stove/Insert Ages, Years
(1: <1, 2: 1-5, 3: 5-10, 4: 10-15, 5: 15+, 6: DK, blank-Not Applicable)

Count	rzip						
q11a>1	99701	99703	99705	99709	99712	99775	Grand Total
1	2		1	1	1		5
2	1	1	11	9	4		26
3	3		1	6	2		12
4	4	1	3	6			14
5	1	2	9	17	1		30
6	2	1	1	2	3		9
	73	16	35	61	17	1	203
Grand Total	86	21	61	102	28	1	299

Q11A Wood Stove/Insert Ages, Years
(1: <1, 2: 1-5, 3: 5-10, 4: 10-15, 5: 15+, 6: DK, blank-Not Applicable)

Count	rzip						
q11a>2	99701	99703	99705	99709	99712	99775	Grand Total
2	1						1
5	1						1
	84	21	61	102	28	1	297
Grand Total	86	21	61	102	28	1	299

Q11B Wood Stove/Insert Catalytic (1-Catalytic, 2-Non-Catalytic, 3-DK, blank-Not Applicable)

Count	rzip						
q11b	99701	99703	99705	99709	99712	99775	Grand Total
1	4	2	9	15	5		35
2	5	3	13	22	5		48
3	4		4	4	1		13
	73	16	35	61	17	1	203
Grand Total	86	21	61	102	28	1	299

Q12 Wood Stove/Insert Fuel (1-Pellets, 2-Cord Wood 3-DK, blank-Not Applicable)

Count	rzip						
q12>1	99701	99703	99705	99709	99712	99775	Grand Total
1	1			2	1		4
2	11	5	26	38	10		90
3	1			1			2
	73	16	35	61	17	1	203
Grand Total	86	21	61	102	28	1	299

Q13 Wood Stove/Insert Burning Daily Profile - Winter
(1-Day, 2-Eve, 3-Day & Eve, 4-Weekend, 5-Eve & Weekend,
6-Occasional, 7-Not Currently Using, 8-DK, 9-Ref, blank-Not Applicable)

Count	rzip						
q13	99701	99703	99705	99709	99712	99775	Grand Total
1		1		4			5
2		1	2	3			6
3	4	1	16	20	7		48
4	1						1
5	2	2	4	6	1		15
6	1		3	5	2		11
7	2						2
8			1				1
9	1						1
	75	16	35	64	18	1	209
Grand Total	86	21	61	102	28	1	299

Q14 Wood Stove/Insert Source (1-Buy, 2-Cut own, 3-DK, blank-Not Applicable)

Count	rzip						
q14>1	99701	99703	99705	99709	99712	99775	Grand Total
1	6	2	9	17			34
2	5	3	17	21	10		56
	75	16	35	64	18	1	209
Grand Total	86	21	61	102	28	1	299

Q14 Wood Stove/Insert Source (1-Buy, 2-Cut own, 3-DK, blank-Not Applicable)

Count	rzip						
q14>2	99701	99703	99705	99709	99712	99775	Grand Total
2	5	2	6	4			17
	81	19	55	98	28	1	282
Grand Total	86	21	61	102	28	1	299

Q15 Wood Stove/Insert Cutting Permit (1-Yes, 2-No, 3-DK, blank-Not Applicable)

Count	rzip						
q15	99701	99703	99705	99709	99712	99775	Grand Total
1	5	2	11	8	4		30
2	5	3	12	16	6		42
3				1			1
	76	16	38	77	18	1	226
Grand Total	86	21	61	102	28	1	299

Q16 Wood Stove/Insert Seasoning (Month, 9999-DK)

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	13.0	15.0	15.3	16.5	8.3	#DIV/0!	14.4

Q17 Wood Stove/Insert Moisture Content (Percent, 9999-DK)

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	1.0	#DIV/0!	7.3	8.3	11.3	#DIV/0!	7.9

Q18 Wood Stove/Insert Wood Cords Used - Annual

Annual Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	3.50	3.50	5.23	3.54	3.30	#DIV/0!	3.95

Q19 Wood Stove/Insert Wood Cords Used - Winter (Oct-March)

Winter Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	3.10	3.25	4.71	3.28	2.70	#DIV/0!	3.60

Q20 Wood Stove/Insert Pellet Bags Used - Annual

Annual Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	250	#DIV/0!	#DIV/0!	9	150	#DIV/0!	104.5

Q21 Wood Stove/Insert Pellet Bags Used - Winter (Oct-March)

Winter Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	175	#DIV/0!	#DIV/0!	8	130	#DIV/0!	80

Q22 Wood Stove/Insert Wood Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	100	1800	610	#DIV/0!	#DIV/0!	1120

Q23 Wood Stove/Insert Pellets Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Section 2: Wood-Burning Fireplace (no insert)

Q24 Wood Fireplace Burning Daily Profile - Winter
(1-Day, 2-Eve, 3-Day & Eve, 4-Weekend, 5-Eve & Weekend,
6-Occasional, 7-Not Currently Using, 8-DK, 9-Ref, blank-Not Applicable)

Count	rzip						
q24	99701	99703	99705	99709	99712	99775	Grand Total
3			3	1			4
5				2			2
	86	21	58	99	28	1	293
Grand Total	86	21	61	102	28	1	299

Q25 Wood Fireplace Source (1-Buy, 2-Cut own, 3-DK, blank-Not Applicable)

Count	rzip						
q25>1	99701	99703	99705	99709	99712	99775	Grand Total
1			1	1			2
2			2	1			3
3				1			1
	86	21	58	99	28	1	293
Grand Total	86	21	61	102	28	1	299

Q25 Wood Fireplace Source (1-Buy, 2-Cut own, 3-DK, blank-Not Applicable)

Count	rzip						
q25>2	99701	99703	99705	99709	99712	99775	Grand Total
2			1	1			2
	86	21	60	101	28	1	297
Grand Total	86	21	61	102	28	1	299

Q26 Wood Fireplace Cutting Permit (1-Yes, 2-No, 3-DK, blank-Not Applicable)

Count	rzip						
q26	99701	99703	99705	99709	99712	99775	Grand Total
1			1	2			3
2			2				2
	86	21	58	100	28	1	294
Grand Total	86	21	61	102	28	1	299

Q27 Wood Fireplace Seasoning (Month, 9999-DK)

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	5.67	18	#DIV/0!	#DIV/0!	10.6

Q28 Wood Fireplace Moisture Content (Percent, 9999-DK)

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Q29 Wood Fireplace Wood Cords Used - Annual

Annual Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	6	4	#DIV/0!	#DIV/0!	5.20

Q30 Wood Fireplace Wood Cords Used - Winter (Oct-March)

Winter Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	5.67	3	#DIV/0!	#DIV/0!	4.60

Q31 Wood Fireplace Wood Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	143.33	630	#DIV/0!	#DIV/0!	338

Section 3: Outdoor Wood Boiler

Q32 Outdoor Wood Boiler Burning Daily Profile - Winter
(1-Day, 2-Eve, 3-Day & Eve, 4-Weekend, 5-Eve & Weekend,
6-Occasional, 7-Not Currently Using, 8-DK, 9-Ref, blank-Not Applicable)

Count	rzip						
q32	99701	99703	99705	99709	99712	99775	Grand Total
7				1			1
	86	21	61	101	28	1	298
Grand Total	86	21	61	102	28	1	299

Q33 Outdoor Wood Boiler Source (1-Buy, 2-Cut own, 3-DK, blank-Not Applicable)

Count	rzip						
q33>1	99701	99703	99705	99709	99712	99775	Grand Total
2				1			1
	86	21	61	101	28	1	298
Grand Total	86	21	61	102	28	1	299

Q34 Outdoor Wood Boiler Cutting Permit (1-Yes, 2-No, 3-DK, blank-Not Applicable)

Count	rzip						
q34	99701	99703	99705	99709	99712	99775	Grand Total
2				1			1
	86	21	61	101	28	1	298
Grand Total	86	21	61	102	28	1	299

Q35 Outdoor Wood Boiler Seasoning (Months, 9999-DK)

Average	rzip						
q35	99701	99703	99705	99709	99712	99775	Grand Total
24				24			24
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Grand Total	#DIV/0!	#DIV/0!	#DIV/0!	24	#DIV/0!	#DIV/0!	24

Q36 Outdoor Wood Boiler Moisture Content (Percent, 9999-DK)

Average of q36	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Q37 Outdoor Wood Boiler Cords Used - Annual

Annual Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total				6			6

Q38 Outdoor Wood Boiler Cords Used - Winter (Oct-March)

Winter Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total				6			6

Q39 Outdoor Wood Boiler Wood Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Section 4: Central Oil Furnace

Q41 Central Oil Fuel Tank Size, Gallons

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	582	600	514	703	624	#DIV/0!	611

Q42 Central Oil Use - Annual, Gallons

Annual Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	1,258	1,083	996	1,141	1,053	#DIV/0!	1,135

Q43 Central Oil Use - Winter (Oct-March), Gallons

Winter Avg	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	805	875	749	883	781	#DIV/0!	818

Q44 Central Oil Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	3,309	2,600	2,992	3,600	3,019	#DIV/0!	3,272

Section 5: Portable Fuel Oil/Kerosene Heating Device

Q45 Portable Heater Fuel Oil Use (1-Yes, 2-No, 3-DK, blank-Not Applicable)

Count	rzip						
q45	99701	99703	99705	99709	99712	99775	Grand Total
1	1	1	2	1	1		6
2	1		1	3			5
3				1			1
	84	20	58	97	27	1	287
Grand Total	86	21	61	102	28	1	299

Q46 Portable Heater Kerosene Use (1-Yes, 2-No, 3-DK, blank-Not Applicable)

Count	rzip						
q46	99701	99703	99705	99709	99712	99775	Grand Total
1	1	1	2	1			5
2	1		1	3	1		6
3				1			1
	84	20	58	97	27	1	287
Grand Total	86	21	61	102	28	1	299

Q47 Portable Heater Fuel Use - Annual, Gallons

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	20	2	300	#DIV/0!	107

Q48 Portable Heater Fuel Use - Winter (Oct-March), Gallons

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	#DIV/0!	#DIV/0!	20	2	300	#DIV/0!	107

Q49 Portable Heater Fuel Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	$2,500	$0	$1,135	$1,650	$300	#DIV/0!	$1,196

Q50 Central/Portable/Other Heating Daily Profile - Winter
(1-Day, 2-Eve, 3-Day & Eve, 4-Weekend, 5-Eve & Weekend,
6-Occasional, 7-Not Currently Using, 8-DK, 9-Ref, blank-Not Applicable)

Count	rzip						
q50	99701	99703	99705	99709	99712	99775	Grand Total
1	2		2	3			7
2		2		1			3
3	70	9	39	69	16		203
5			1	3	1		5
6		1	6	2	3		12
7	4	1	2	3	2		12
8	1			2	2		5
9			1	1	1		3
	9	8	10	18	3	1	49
Grand Total	86	21	61	102	28	1	299

Section 6: Toyo, Monitor, or Other Direct-Vent Heater

Q51 Direct Vent Heater Only Fuel Use - Annual, Gallons

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	700	#DIV/0!	733	403	417	#DIV/0!	493

Q52 Direct Vent Heater Only Fuel Use - Winter (Oct-March), Gallons

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	625	#DIV/0!	633	311	417	#DIV/0!	444

Q53 Direct Vent Heater Fuel Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	2,225	100	850	1,417	1,375	#DIV/0!	1,389

Q54 Direct Vent Heater Heating Daily Profile - Winter
(1-Day, 2-Eve, 3-Day & Eve, 4-Weekend, 5-Eve & Weekend,
6-Occasional, 7-Not Currently Using, 8-DK, 9-Ref, blank-Not Applicable)

Count of q54	rzip						
q54	99701	99703	99705	99709	99712	99775	Grand Total
1	1		1	1			3
2		1	1		1		3
3	9	4	3	15	4		35
5				1			1
6		1	2	1			4
7	2				1		3
8				2	2		4
9				1			1
	74	15	54	81	20	1	245
Grand Total	86	21	61	102	28	1	299

Section 7: Natural Gas Heating Device

Q55 Natural Gas Heating Fuel Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	$1,950	$900	n/a	$2,717	n/a	n/a	$2,159

Q56 Natural Gas Heating Fuel Cost - Winter (Oct-March), Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	$1,700	$700	#DIV/0!	$1,180	#DIV/0!		$1,260

Section X: Coal Heating Device

Q57 Coal Use - Annual, Bags

Average	rzip						
	99701	99702	99703	99705	99709	99775	Grand Total
Total	9						9

Q58 Coal Cost - Annual, Dollars/Bag

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total				$108			$108

Q59 Coal Cost - Winter (Oct-March), Dollars/Bag

Average	rzip						
	99701	99702	99703	99705	99709	99775	Grand Total
Total							

Q60 Coal Heating Place (1-Indoor Stove, 2-Outdoor Boiler, blank-Not Applicable)

Count	rzip						
q60	99701	99703	99705	99709	99712	99775	Grand Total
1			1	1			2
2	1			1			2
	85	21	60	100	28	1	295
Grand Total	86	21	61	102	28	1	299

Section F: Municipal Heat

Q61 Municipal Heating Fuel Cost - Annual, Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	$2,800	$2,000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	$2,400

Q62 Municipal Heating Fuel Cost - Winter (Oct-March), Dollars

Average	rzip						
	99701	99703	99705	99709	99712	99775	Grand Total
Total	$1,500	$1,200	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	$1,350

Future Use Section

Q63 Planned New or Different Heating Device (1-Yes, 2-No, 3-DK)

Count	rzip						
q63	99701	99703	99705	99709	99712	99775	Grand Total
1	16	1	10	13	10		50
2	69	18	49	87	18	1	242
3	1	2	2	2			7
Grand Total	86	21	61	102	28	1	299

Q64 Planned New/Replacement Device Type
(1-Wood, 2-Pellet, 3-Outdoor wood boiler 4-Fuel oil, 5-Kerosene, blank-Not Applicable)

Count	rzip						
q65	99701	99703	99705	99709	99712	99775	Grand Total
1	6	3	12	14	3		38
2	5	2	16	26	7		56
3			1	1			2
	75	16	32	61	18	1	203
Grand Total	86	21	61	102	28	1	299

Q64a Offset Years to Buy a New Wood Stove
(1: 1 yr, 2: 2 yrs, 3: 3 yrs, 4: 4 yrs, 5: 5+ yrs, 6: None, 7: DK, blank: Not Applicable)

Count	rzip						
q64a	99701	99703	99705	99709	99712	99775	Grand Total
1	1			1			2
2	1		2				3
3	1			2			3
4				1			1
5			1	1	1		3
7				1	1		2
	83	21	58	96	26	1	285
Grand Total	86	21	61	102	28	1	299

Q64b Willing to Buy a New Stove with $250 Incentive (1-Yes, 2-No, blank-Not Applicable)

Count	rzip						
q64b	99701	99703	99705	99709	99712	99775	Grand Total
1	3		2	5			10
2			1	1	2		4
	83	21	58	96	26	1	285
Grand Total	86	21	61	102	28	1	299

Q64c Willing to Buy a New Stove with $500 Incentive (1-Yes, 2-No, blank-Not Applicable)

Count	rzip						
q64c	99701	99703	99705	99709	99712	99775	Grand Total
1			1		2		3
2				1			1
	86	21	60	101	26	1	295
Grand Total	86	21	61	102	28	1	299

Q64d Willing to Buy a New Stove with $750 Incentive (1-Yes, 2-No, blank-Not Applicable)

Count of q64d	rzip						
q64d	99701	99703	99705	99709	99712	99775	Grand Total
2				1			1
	86	21	61	101	28	1	298
Grand Total	86	21	61	102	28	1	299

Q64e Willing to Buy a New Stove with $1000 Incentive (1-Yes, 2-No, blank-Not Applicable)

Count of q64e	rzip						
q64e	99701	99703	99705	99709	99712	99775	Grand Total
2				1			1
	86	21	61	101	28	1	298
Grand Total	86	21	61	102	28	1	299

Q64f Amonunt of Incentive to to Buy a New Wood Stove (1: $1000-$1200, 2: $1201-$1500, 3: $1501-$1750, 4: $1751-$2000, 5: $2001 or more, 6: DK, blank-Not Applicable)

Count	rzip						
q64f	99701	99703	99705	99709	99712	99775	Grand Total
6				1			1
	86	21	61	101	28	1	298
Grand Total	86	21	61	102	28	1	299

Q65 Burned More Wood Last Winter (1-Yes, 2-No, 3-DK, blank-Not Applicable)

Count	rzip						
q65	99701	99703	99705	99709	99712	99775	Grand Total
1	6	3	12	14	3		38
2	5	2	16	26	7		56
3			1	1			2
	75	16	32	61	18	1	203
Grand Total	86	21	61	102	28	1	299

Q66 Fuel Oil Price To Stop Using Wood, Dollars

	rzip						
Data	99701	99703	99705	99709	99712	99775	Grand Total
Average	$1.46	$1.95	$1.74	$1.78	$2.00		$1.74
Min	$0.50	$1.95	$0.85	$0.00	$1.00		$0.00
Max	$2.00	$1.95	$3.51	$5.00	$3.00		$5.00
StdDev	$0.61	#DIV/0!	$0.79	$1.27	$1.00		$1.04
Households That Would Always Burn Wood	3	0	3	5	0	0	11
Households That Say "Much Cheaper"	1	1	1	1	1	0	5

Q67 Willing to Participate in Monitoring Wood & Heating Oil Use (1-Yes, 2-No, 3-DK, blank-Not Applicable)

Count	rzip						
q67	99701	99703	99705	99709	99712	99775	Grand Total
1	8	4	13	27	5		57
2	1	1	13	13	5		33
3	2		3	1			6
	75	16	32	61	18	1	203
Grand Total	86	21	61	102	28	1	299

Q68 Willing to Participate in Determining Moisture Content of Wood (1-Yes, 2-No, blank-Not Applicable)

Count of q68	rzip						
q68	99701	99703	99705	99709	99712	99775	Grand Total
1	6	4	12	29	7		58
2	5	1	16	12	3		37
3			1				1
	75	16	32	61	18	1	203
Grand Total	86	21	61	102	28	1	299

Q69 Live Inside/Outside of Chena Ridge (1-Inside, 2-Outside, 3-DK, blank-Not Applicable)

Count	rzip						
q69	99701	99703	99705	99709	99712	99775	Grand Total
1				29			29
2				57			57
3				16			16
	86	21	61		28	1	197
Grand Total	86	21	61	102	28	1	299

Q70 Live Inside/Outside of Farmers Loop Road (1-Inside, 2-Outside, 3-DK/Ref, blank-Not Applicable)

Count	rzip						
q70	99701	99703	99705	99709	99712	99775	Grand Total
1					1		1
2					26		26
3					1		1
	86	21	61	102		1	271
Grand Total	86	21	61	102	28	1	299

Q71 Media Watch : Keeping Abreast of Current Issues
(1-TV, 2-Radio, 3-Newspaper, 4-Internet, 5-Other, 6-DK, blank-Not Applicable)

Sum of q71>1	rzip						
q71>1	99701	99703	99705	99709	99712	99775	Grand Total
1	53	14	35	57	14	1	174
2	18	4	14	36	10		82
3	45	3	24	54	3		129
4	24	8	40	28	16		116
5	10	5	5	5	15		40
6	6	6		6	6		24
Grand Total	156	40	118	186	64	1	565

Q71 Media Watch : Keeping Abreast of Current Issues
(1-TV, 2-Radio, 3-Newspaper, 4-Internet, 5-Other, 6-DK, blank-Not Applicable)

Count of q71>2	rzip						
q71>2	99701	99703	99705	99709	99712	99775	Grand Total
2	26	9	18	37	10	1	101
3	14	3	8	22	3		50
4	7	1	14	10	3		35
5	2			1			3
	37	8	21	32	12		110
Grand Total	86	21	61	102	28	1	299

Q71 Media Watch : Keeping Abreast of Current Issues
(1-TV, 2-Radio, 3-Newspaper, 4-Internet, 5-Other, 6-DK, blank-Not Applicable)

Count of q71>3	rzip						
q71>3	99701	99703	99705	99709	99712	99775	Grand Total
3	23	7	15	30	8	1	84
4	4	1	3	16	1		25
5	1			1			2
	58	13	43	55	19		188
Grand Total	86	21	61	102	28	1	299

Q71 Media Watch : Keeping Abreast of Current Issues
(1-TV, 2-Radio, 3-Newspaper, 4-Internet, 5-Other, 6-DK, blank-Not Applicable)

Count of q71>4	rzip						
q71>4	99701	99703	99705	99709	99712	99775	Grand Total
4	18	7	13	22	8	1	69
5	1						1
	67	14	48	80	20		229
Grand Total	86	21	61	102	28	1	299

Q71 Media Watch : Keeping Abreast of Current Issues
(1-TV, 2-Radio, 3-Newspaper, 4-Internet, 5-Other, 6-DK, blank-Not Applicable)

Count of q71>5	rzip						
q71>5	99701	99703	99705	99709	99712	99775	Grand Total
5	10	2	2	10	4		28
	76	19	59	92	24	1	271
Grand Total	86	21	61	102	28	1	299

APPENDIX C

2010 Fairbanks Home Heating Survey Normalized Tabulations

TABULATIONS OF FAIRBANKS 2010 HOME HEATING SURVEY

Parameter	Stat	Type	99701 Downtown	99703 Wainwright	99705 North Pole	99709 Airport	99712 Steese	99775 University	All All
Survey Sample	# Obs		86	21	61	102	28	1	299
(Self-weighted by ZIP households)	% Obs		**28.8%**	**7.0%**	**20.4%**	**34.1%**	**9.4%**	**0.3%**	**100.0%**
Multiple Type Heating	UseFactor	(1.0=Single)	**1.40**	**1.62**	**1.59**	**1.68**	**1.61**	**1.00**	**1.57**
Average Use by Type, Winter (October-March)	**% Obs**	**Wood**	**6.8%**	**9.8%**	**28.6%**	**20.1%**	**19.5%**	**0.0%**	**17.2%**
	% Obs	**Central Oil**	**80.8%**	**44.3%**	**63.2%**	**63.2%**	**69.6%**	**0.0%**	**67.3%**
	% Obs	**Portable**	**0.1%**	**2.4%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.2%**
	% Obs	**Direct Vent**	**7.0%**	**17.4%**	**3.5%**	**9.7%**	**10.5%**	**0.0%**	**8.2%**
	% Obs	**Natural Gas**	**4.7%**	**14.3%**	**1.6%**	**4.4%**	**0.0%**	**100.0%**	**4.5%**
	% Obs	**Coal Heat**	**0.0%**	**0.0%**	**0.1%**	**1.5%**	**0.0%**	**0.0%**	**0.5%**
	% Obs	**Muni. Heat**	**0.6%**	**11.7%**	**1.6%**	**0.0%**	**0.0%**	**0.0%**	**1.3%**
	% Obs	**Other**	**0.1%**	**0.2%**	**1.2%**	**1.1%**	**0.4%**	**0.0%**	**0.7%**
		All	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Wood Burning Type (Q1a)	# Obs	Fireplace	0	0	3	3	0	0	6
	# Obs	FP+Insert	1	1	1	3	1	0	7
	# Obs	Stove	12	4	25	38	10	0	89
	# Obs	Wood Boiler	0	0	0	1	0	0	1
	# Obs	Unknown	0	0	0	1	0	0	1
	# Obs	N/A	73	16	32	56	17	1	195
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	13	5	29	45	11	0	103
	% Obs	**Fireplace**	**0.0%**	**0.0%**	**10.3%**	**6.7%**	**0.0%**	**0.0%**	**5.8%**
	% Obs	**FP+Insert**	**7.7%**	**20.0%**	**3.4%**	**6.7%**	**9.1%**	**0.0%**	**6.8%**
	% Obs	**Stove**	**92.3%**	**80.0%**	**86.2%**	**84.4%**	**90.9%**	**0.0%**	**86.4%**
	% Obs	**Wood Boiler**	**0.0%**	**0.0%**	**0.0%**	**2.2%**	**0.0%**	**0.0%**	**1%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**
Wood Stove/Insert Installation Year / Cert Type (Q10a)	# Obs	<1988 (Un-Certified)	2	3	12	13	1	0	31
	# Obs	>=1988 (Certified)	10	2	14	25	9	0	60
	# Obs	Unknown	1	0	0	3	1	0	5
	# Obs	N/A	73	16	35	61	17	1	203
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	12	5	26	38	10	0	91
	% Obs	**<1988 (Un-Certified)**	**16.7%**	**60.0%**	**46.2%**	**34.2%**	**10.0%**	**0.0%**	**34.1%**
	% Obs	**>=1988 (Certified)**	**83.3%**	**40.0%**	**53.8%**	**65.8%**	**90.0%**	**0.0%**	**65.9%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**
Wood Stove/Insert Fuel Type (Q12)	# Obs	Pellets	1	0	0	2	1	0	4
	# Obs	Cord Wood	11	5	26	38	10	0	90
	# Obs	Unknown	1	0	0	1	0	0	2
	# Obs	N/A	73	16	35	61	17	1	203
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	12	5	26	40	11	0	94
	% Obs	**Pellets**	**8.3%**	**0.0%**	**0.0%**	**5.0%**	**9.1%**	**0.0%**	**4.3%**
	% Obs	**Cord Wood**	**91.7%**	**100.0%**	**100.0%**	**95.0%**	**90.9%**	**0.0%**	**95.7%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**
Wood Stove/Insert Daily Use Profile, Winter (Q13)	# Obs	Daytime	0	1	0	4	0	0	5
	# Obs	Evening	0	1	2	3	0	0	6
	# Obs	Day&Eve	4	1	16	20	7	0	48
	# Obs	Weekend	1	0	0	0	0	0	1
	# Obs	Eve&WkEnd	2	2	4	6	1	0	15
	# Obs	Occasional	1	0	3	5	2	0	11
	# Obs	Not Using	2	0	0	0	0	0	2
	# Obs	Unknown	0	0	1	0	0	0	1
	# Obs	N/A	1	0	0	0	0	0	1
	# Obs	All	75	16	35	64	18	1	209
	# Obs	All With	10	5	25	38	10	0	88
	% Obs	**Daytime**	**0.0%**	**20.0%**	**0.0%**	**10.5%**	**0.0%**	**0.0%**	**5.7%**
	% Obs	**Evening**	**0.0%**	**20.0%**	**8.0%**	**7.9%**	**0.0%**	**0.0%**	**6.8%**
	% Obs	**Day&Eve**	**40.0%**	**20.0%**	**64.0%**	**52.6%**	**70.0%**	**0.0%**	**54.5%**
	% Obs	**Weekend**	**10.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**1.1%**
	% Obs	**Eve&WkEnd**	**20.0%**	**40.0%**	**16.0%**	**15.8%**	**10.0%**	**0.0%**	**17.0%**
	% Obs	**Occasional**	**10.0%**	**0.0%**	**12.0%**	**13.2%**	**20.0%**	**0.0%**	**12.5%**
	% Obs	**Not Using**	**20.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**2.3%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**
Wood Stove/Insert Wood Source (Q14)	# Obs	Cut Own-multi response	5	2	6	4	0	0	17
	# Obs	Buy	6	2	9	17	0	0	34
	# Obs	Cut Own	5	3	17	21	10	0	56
	# Obs	Unknown	75	16	35	64	18	1	209
	# Obs	N/A	86	21	61	102	28	1	299
	# Obs	All	0	0	0	0	0	0	0
	# Obs	All With	11	5	26	38	10	0	90
	% Obs	**Buy**	**54.5%**	**40.0%**	**34.6%**	**44.7%**	**0.0%**	**0.0%**	**37.8%**
	% Obs	**Cut Own**	**90.9%**	**100.0%**	**88.5%**	**65.8%**	**100.0%**	**0.0%**	**81.1%**
	% Obs	**All With**	**145.5%**	**140.0%**	**123.1%**	**110.5%**	**100.0%**	**0.0%**	**118.9%**
Wood Stove/Insert Cutting Permit Obtained (Q15)	# Obs	Yes	5	2	11	8	4	0	30
	# Obs	No	5	3	12	16	6	0	42
	# Obs	Unknown	0	0	0	1	0	0	1
	# Obs	N/A	76	16	38	77	18	1	226
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	10	5	23	24	10	0	72
	% Obs	**Yes**	**50.0%**	**40.0%**	**47.8%**	**33.3%**	**40.0%**	**0.0%**	**41.7%**
	% Obs	**No**	**50.0%**	**60.0%**	**52.2%**	**66.7%**	**60.0%**	**0.0%**	**58.3%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**

TABULATIONS OF FAIRBANKS 2010 HOME HEATING SURVEY

Parameter	Stat	Type	99701 Downtown	99703 Wainwright	99705 North Pole	99709 Airport	99712 Steese	99775 University	All All
Wood Fireplace Daily Use Profile, Winter (Q24)	# Obs	Daytime							
	# Obs	Evening							
	# Obs	Day&Eve	0	0	3	1	0	0	4
	# Obs	Weekend							
	# Obs	Eve&WkEnd	0	0	0	2	0	0	2
	# Obs	Occasional							
	# Obs	Not Using							
	# Obs	Unknown							
	# Obs	N/A	86	21	58	99	28	1	293
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	0	0	3	3	0	0	6
	% Obs	**Daytime**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
	% Obs	**Evening**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
	% Obs	**Day&Eve**	**0.0%**	**0.0%**	**100.0%**	**33.3%**	**0.0%**	**0.0%**	**66.7%**
	% Obs	**Weekend**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
	% Obs	**Eve&WkEnd**	**0.0%**	**0.0%**	**0.0%**	**66.7%**	**0.0%**	**0.0%**	**33.3%**
	% Obs	**Occasional**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
	% Obs	**Not Using**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
	% Obs	**All With**	**0.0%**	**0.0%**	**100.0%**	**100.0%**	**0.0%**	**0.0%**	**100.0%**
Wood Fireplace Wood Source (Q25)	# Obs	Buy	0	0	1	1	0	0	2
	# Obs	Cut Own	0	0	2	1	0	0	3
	# Obs	Unknown	0	0	0	1	0	0	1
	# Obs	N/A	86	21	58	99	28	1	293
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	0	0	3	2	0	0	5
	% Obs	**Buy**	**0.0%**	**0.0%**	**33.3%**	**50.0%**	**0.0%**	**0.0%**	**40.0%**
	% Obs	**Cut Own**	**0.0%**	**0.0%**	**66.7%**	**50.0%**	**0.0%**	**0.0%**	**60.0%**
	% Obs	**All With**	**0.0%**	**0.0%**	**100.0%**	**100.0%**	**0.0%**	**0.0%**	**100.0%**
Wood Fireplace Cutting Permit Obtained (Q26)	# Obs	Yes	0	0	1	2	0	0	3
	# Obs	No	0	0	2	0	0	0	2
	# Obs	Unknown							
	# Obs	N/A	86	21	58	100	28	1	294
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	0	0	3	2	0	0	5
	% Obs	**Yes**	**0.0%**	**0.0%**	**33.3%**	**100.0%**	**0.0%**	**0.0%**	**60.0%**
	% Obs	**No**	**0.0%**	**0.0%**	**66.7%**	**0.0%**	**0.0%**	**0.0%**	**40.0%**
	% Obs	**All With**	**0.0%**	**0.0%**	**100.0%**	**100.0%**	**0.0%**	**0.0%**	**100.0%**
Stove/Insert Wood Use (cords), Annual (Q18)	**Average**	**Per Equipped Household**	**3.50**	**3.50**	**5.23**	**3.54**	**3.30**	**#DIV/0!**	**3.95**
Stove/Insert Wood Use (cords), Winter (Q19)	**Average**	**Per Equipped Household**	**3.10**	**3.25**	**4.71**	**3.28**	**2.70**	**#DIV/0!**	**3.60**
Fireplace Wood Use (cords), Annual (Q29)	**Average**	**Per Equipped Household**	**#DIV/0!**	**#DIV/0!**	**6.00**	**4.00**	**#DIV/0!**	**#DIV/0!**	**5.20**
Fireplace Wood Use (cords), Winter (Q30)	**Average**	**Per Equipped Household**	**#DIV/0!**	**#DIV/0!**	**5.67**	**3.00**	**#DIV/0!**	**#DIV/0!**	**4.60**
Central Oil Use (gallons), Annual (Q42)	**Average**	**Per Equipped Household**	**1,258**	**1,083**	**996**	**1,141**	**1,053**	**#DIV/0!**	**1,135**
Central Oil Use (gallons), Winter (Q43)	**Average**	**Per Equipped Household**	**805**	**875**	**749**	**883**	**781**	**#DIV/0!**	**818**
Central Oil, Portable Heater Daily Use Profile, Winter (Q50)	# Obs	Daytime	2	0	2	3	0	0	7
	# Obs	Evening	0	2	0	1	0	0	3
	# Obs	Day&Eve	70	9	39	69	16	0	203
	# Obs	Weekend	0	0	1	3	1	0	5
	# Obs	Eve&WkEnd	0	1	6	2	3	0	12
	# Obs	Occasional	4	1	2	3	2	0	12
	# Obs	Not Using	1	0	0	2	2	0	5
	# Obs	Unknown	0	0	1	1	1	0	3
	# Obs	N/A	9	8	10	18	3	1	49
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	77	13	50	83	24	0	247
	% Obs	**Daytime**	**2.6%**	**0.0%**	**4.0%**	**3.6%**	**0.0%**	**0.0%**	**2.8%**
	% Obs	**Evening**	**0.0%**	**15.4%**	**0.0%**	**1.2%**	**0.0%**	**0.0%**	**1.2%**
	% Obs	**Day&Eve**	**90.9%**	**69.2%**	**78.0%**	**83.1%**	**66.7%**	**0.0%**	**82.2%**
	% Obs	**Weekend**	**0.0%**	**0.0%**	**2.0%**	**3.6%**	**4.2%**	**0.0%**	**2.0%**
	% Obs	**Eve&WkEnd**	**0.0%**	**7.7%**	**12.0%**	**2.4%**	**12.5%**	**0.0%**	**4.9%**
	% Obs	**Occasional**	**5.2%**	**7.7%**	**4.0%**	**3.6%**	**8.3%**	**0.0%**	**4.9%**
	% Obs	**Not Using**	**1.3%**	**0.0%**	**0.0%**	**2.4%**	**8.3%**	**0.0%**	**2.0%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**
Portable Heater Fuel Type (Q45 & Q46)	# Obs	Fuel Oil - Yes	1	1	2	1	1	0	6
	# Obs	Fuel Oil - No	1	0	1	3	0	0	5
	# Obs	Kerosene - Yes	1	1	2	1	0	0	5
	# Obs	Kerosene - No	1	0	1	3	1	0	6
	# Obs	Unknown	0	0	0	1	0	0	1
	# Obs	N/A	84	20	58	97	27	1	287
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	2	1	3	4	1	0	11
	% Obs	**Fuel Oil**	**50.0%**	**50.0%**	**50.0%**	**50.0%**	**100.0%**	**0.0%**	**54.5%**
	% Obs	**Kerosene**	**50.0%**	**50.0%**	**50.0%**	**50.0%**	**0.0%**	**0.0%**	**45.5%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**
Portable Heater Fuel Use (gallons), Annual (Q47)	**Average**	**Per Equipped Household**	**#DIV/0!**	**#DIV/0!**	**20**	**2**	**300**	**#DIV/0!**	**107**
Portable Heater Fuel Use (gallons), Winter (Q48)	**Average**	**Per Equipped Household**	**#DIV/0!**	**#DIV/0!**	**20**	**2**	**300**	**#DIV/0!**	**107**
Direct Vent Heater Fuel Use (gallons), Annual (Q51)	**Average**	**Per Equipped Household**	**700**	**#DIV/0!**	**733**	**403**	**417**	**#DIV/0!**	**493**
Direct Vent Heater Fuel Use (gallons), Winter (Q52)	**Average**	**Per Equipped Household**	**625**	**#DIV/0!**	**633**	**311**	**417**	**#DIV/0!**	**444**
Natural Gas Heating Fuel Cost (dollars), Annual (Q55)	**Average**	**Per Equipped Household**	**$1,950**	**$900**	**n/a**	**$2,717**	**n/a**	**n/a**	**$2,159**
Natural Gas Heating Fuel Cost (dollars), Winter (Q56)	**Average**	**Per Equipped Household**	**$1,700**	**$700**	**#DIV/0!**	**$1,180**	**#DIV/0!**	**$0**	**$1,260**
Municipal Heating Fuel Cost (dollars), Annual (Q61)	**Average**	**Per Equipped Household**	**$2,800**	**$2,000**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**$2,400**
Municipal Heating Fuel Cost (dollars), Winter (Q62)	**Average**	**Per Equipped Household**	**$1,500**	**$1,200**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**$1,350**

TABULATIONS OF FAIRBANKS 2010 HOME HEATING SURVEY									
			99701	99703	99705	99709	99712	99775	All
Parameter	Stat	Type	Downtown	Wainwright	North Pole	Airport	Steese	University	All
Planned New or Different Heating within 2 Yrs (Q63)	# Obs	Yes	16	1	10	13	10	0	50
	# Obs	No	69	18	49	87	18	1	242
	# Obs	Unknown	1	2	2	2	0	0	7
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	85	19	59	100	28	1	292
	% Obs	**Yes**	**18.8%**	**5.3%**	**16.9%**	**13.0%**	**35.7%**	**0.0%**	**17.1%**
	% Obs	**No**	**81.2%**	**94.7%**	**83.1%**	**87.0%**	**64.3%**	**100.0%**	**82.9%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Burned More Wood Last Winter (Q65)	# Obs	Yes	6	3	12	14	3	0	38
	# Obs	No	5	2	16	26	7	0	56
	# Obs	Unknown	0	0	1	1	0	0	2
	# Obs	N/A	75	16	32	61	18	1	203
	# Obs	All	86	21	61	102	28	1	299
	# Obs	All With	11	5	28	40	10	0	94
	% Obs	**Yes**	**54.5%**	**60.0%**	**42.9%**	**35.0%**	**30.0%**	**0.0%**	**40.4%**
	% Obs	**No**	**45.5%**	**40.0%**	**57.1%**	**65.0%**	**70.0%**	**0.0%**	**59.6%**
	% Obs	**All With**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**	**100.0%**
Fuel Price to Stop Using Wood, $/gal (Q66)	**Mean**	**Per Equipped Household**	**$1.46**	**$1.95**	**$1.74**	**$1.78**	**$2.00**	**$0.00**	**$1.74**
	Minimum	**Per Equipped Household**	**$0.50**	**$1.95**	**$0.85**	**$0.00**	**$1.00**	**$0.00**	**$0.00**
	Maximum	**Per Equipped Household**	**$2.00**	**$1.95**	**$3.51**	**$5.00**	**$3.00**	**$0.00**	**$5.00**
	Std Dev	**Per Equipped Household**	**$0.61**	**#DIV/0!**	**$0.79**	**$1.27**	**$1.00**	**$0.00**	**$1.04**
Wood Stove/Insert Seasoning (months) (Q16)	**Average**	**Month**	**13.0**	**15.0**	**15.3**	**16.5**	**8.3**	**#DIV/0!**	**14.4**
Wood Stove/Insert Moisture Content (%) (Q17)	**% Obs**		**1.00%**	**#DIV/0!**	**7.25%**	**8.33%**	**11.25%**	**#DIV/0!**	**7.88%**