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**Subject:** Fairbanks 2011 Home Heating Survey Update

## Introduction

A home heating survey was conducted for the 2010-2011 winter season in Fairbanks, Alaska. Comparable home heating surveys were conducted previously in 2006, 2007, and 2010. The initial results of this home heating survey are presented in the tables below, along with a discussion of observations.

The sample size for this survey was expanded from the 300 households surveyed in 2010 to 712 households for 2011. For 2011, the sample call list contained both a cell phone only group (86 households) as well as a landline group (626 households). The sample pool was distributed across multiple zip codes for Fairbanks: 99701, 99703, 99705, 99712, and 99775. Sample sizes for each zip code were proportional to population estimates from 2000 census data for the landline group. In contrast to the landline group, the cell phone group was randomly sampled across all zip codes based on Fairbanks mobile phone prefixes. Cell phone respondents were asked to confirm that they resided within Fairbanks.

The survey consists of 72 questions organized in a branching structure. Similar to the 2010 survey, respondents were queried regarding the presence of home heating devices as well as device and fuel usage, device and fuel properties, fuel costs, future home heating plans, and the respondent's perception of the air quality in Fairbanks.

## Methodology

Table 1 shows the total households for the PM<sub>2.5</sub> nonattainment area by zip code along with the fraction of total households and the number of households sampled. It is worth noting that the cell phone group is not broken down by zip code, and therefore it is unclear how the cell phone responses should be incorporated in the regional (and sub-regional) analysis of home heating usage. At this time, it represents a previously untapped group that shows a significantly different response pattern from the region as a whole.

ZIP Code	Area	Households <sup>a</sup>	Household Fraction (%)	Sampling Target
N/A	Cell Phone	n/a	n/a	86
99701	Downtown	7,164	28.0%	181
99703	Wainwright & Birch Hill	1,822	7.1%	27
99705	North Pole	5,329	20.8%	139
99709	Airport	8,774	34.3%	214
99712	Steese	2,389	9.3%	59
99775	University	105	0.4%	6
TOTALS		25,583	100%	<b>712</b>

<sup>a</sup> from 2000 U.S. Census

## Results Summary

Table 2 summarizes the findings for the PM<sub>2.5</sub> nonattainment region as a whole across 2006, 2007, 2010, and 2011. The values in the first section of Table 2—“Average Winter Device Use by Type”—reflect the respondent’s estimate of a device’s contribution to the overall home heating. In terms of the device usage estimates, the 2011 survey closely matches the values seen for the 2010 survey. Of note are the differences observed in the two most significant device categories: wood burning and central oil. Central oil usage estimates increased by 0.7% over 2010, and wood device usage declined by 2.4%. Compared to the 2006 and 2007 surveys, the wood device usage is higher by 4.7 and 3%, respectively, and central oil is 0 and 4.4% higher.

The second section of Table 2—“Wood Burning Type”—breaks down the wood category from section 1 into four device subcategories, again based on a respondent’s estimates of usage. Fireplace, insert, and woodstove devices show a small decline as a fraction of wood devices in 2011 of 0.5, 1.1, and 1.4%, respectively. The wood boiler category makes up a 3% larger fraction of wood devices in 2011.

The fraction of certified stoves as calculated based on the age of the device has increased in the 2011 sample group by 11.7%, as shown in the third section, “Wood Stove/Insert Cert Type.”

Winter fuel use by device type is broken down in the last section of Table 2. Both the wood stove cord and fireplace cord numbers have decreased (0.41 wood stove/insert cords and 3.0 fireplace cords) from 2010 to 2011; however, both values remain above the 2006 and 2007 survey values. Central oil fuel usage increased in the sample group by 159 gallons from 2010, as did portable heater fuel usage by 108.7 gallons; direct vent fuel use, however, declined by 61 gallons in the 2011 survey. Natural gas fuel cost on average increased by \$432 over 2010, while the municipal heating fuel costs declined \$92 in 2011.

Statistic	Parameter	Survey Results			
		2006 <sup>a</sup>	2007 <sup>a</sup>	2010	2011
Average Winter Device Use by Type (% of Household Use)	Wood	<b>10.1%</b>	<b>11.8%</b>	<b>17.2%</b>	<b>14.8%</b>
	Central Oil	68.0%	63.6%	67.3%	68.0%
	Portable	0.7%	0.5%	0.2%	0.9%
	Direct Vent	8.6%	7.4%	8.2%	9.2%
	Natural Gas	2.6%	2.3%	4.5%	3.3%
	Coal Heat	n/a	n/a	0.5%	0.6%
	District Heat	2.8%	1.1%	1.3%	1.9%
	Electric Device	n/a	n/a	n/a	0.5%
	Other	7.2%	13.4%	0.7%	0.9%
Wood Burning Type (% of Wood-Burning Devices)	Fireplace	<b>13.0%</b>	<b>17.5%</b>	<b>5.8%</b>	<b>5.3%</b>
	Fireplace + Insert	8.3%	5.6%	6.8%	5.7%
	Woodstove	<b>78.8%</b>	<b>76.9%</b>	<b>86.4%</b>	<b>85.0%</b>
	Wood Boiler	n/a	n/a	1.0%	4.0%
Wood Stove/Insert Cert Type (% of Woodstoves/Inserts)	<1988 (Un-Certified)	<b>52.4%</b>	<b>46.8%</b>	<b>34.1%</b>	<b>22.4%</b>
	≥1988 (Certified)	<b>47.6%</b>	<b>53.2%</b>	<b>65.9%</b>	<b>77.6%</b>
Stove/Insert Wood Use (cords), Winter	Winter Season	<b>2.87</b>	<b>2.85</b>	<b>3.60</b>	<b>3.19</b>
Fireplace Wood Use (cords), Winter	Winter Season	<b>0.76</b>	<b>0.74</b>	<b>4.60</b>	<b>1.6</b>
Central Oil Use (gallons), Winter	Winter Season	<b>1,099</b>	<b>1,011</b>	<b>818</b>	<b>977</b>
Portable Heater Fuel Use (gallons), Winter	Winter Season	91.7	152.7	107.3	216.0
Direct Vent Heater Fuel Use (gallons), Winter	Winter Season	296	472	444	383
Natural Gas Heating Fuel Cost (dollars), Winter	Winter Season	<b>\$553</b>	<b>\$947</b>	<b>\$1,260</b>	<b>\$1,692</b>
Municipal Heating Fuel Cost (dollars), Winter	Winter Season	n/a	n/a	\$1,350	\$1,258

<sup>a</sup> Winter usage in these surveys encompassed October-May; 2010 and 2011 winter usage spanned October-March.

To assess the 2011 survey, results have been broken into zip code and cell phone groups. Table 3 highlights the sample sizes for each sub group as well as their fraction of the total survey. The number of devices per household on average was calculated in the row "Multi-Type Household Factor." A value of 1.0 would translate to 1 heating device per household on average, whereas a value of 2.0 would indicate 2 heating devices per household on average. For the PM<sub>2.5</sub> nonattainment region as a whole, this value comes to 1.53 devices used per household. North Pole, Airport, and Steese zip codes have the three highest device counts per household, while the lowest device counts occur in Downtown and University.

	Cell Phone No Zip	Downtown 99701	Wainwright <sup>a</sup> 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Survey Sample	86	181	27	139	214	59	6	712
	12.1%	25.4%	3.8%	19.5%	30.1%	8.3%	0.8%	100.0%
Multi-Type Household Factor	1.56	1.31	1.52	1.58	1.61	1.76	1.33	1.53

<sup>a</sup> Also includes Birch Hill area

### Survey Device Counts

Raw device counts are broken down by zip code and device type in table 4. These values do not reflect device usage but simply the presence of such a device in the sample household. Based on these counts it is clear that central oil, wood burning, and direct vent devices are the most prevalent in the Fairbanks PM<sub>2.5</sub> nonattainment region in 2011. This trend is consistent across most of the zip codes, with a few exceptions. The University zip code did not receive any direct vent responses. The Wainwright zip code group contained more natural gas devices than direct vent. In all sub regions central oil was the most abundant device type. Wood devices were second-most abundant with exception of the cell phone group. Direct vent devices were third, with the exception of the cell phone group and Wainwright.

Heating Device Type	Cell Phone No Zip	Downtown 99701	Wainwright <sup>a</sup> 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Wood Burning	24	30	7	59	92	27	1	<b>240</b>
Central Oil Furnace	55	149	15	120	173	47	5	<b>564</b>
Portable Heat Device	8	6	2	6	10	3	1	<b>36</b>
Direct Vent Type	27	21	5	21	42	13	0	<b>129</b>
Natural Gas	6	8	6	3	3	1	1	<b>28</b>
Coal Heating	2	2	0	2	2	2	0	<b>10</b>
District Heating	2	9	4	1	4	1	0	<b>21</b>
Electric Heating	4	5	1	0	6	3	0	<b>19</b>
Other	6	8	1	8	12	7	0	<b>42</b>
<b>TOTALS</b>	<b>134</b>	<b>238</b>	<b>41</b>	<b>220</b>	<b>344</b>	<b>104</b>	<b>8</b>	<b>1089</b>

<sup>a</sup> Also includes Birch Hill area

Device counts alone do not accurately reflect device usage by residents in Fairbanks. Respondents in the home heating survey were asked to estimate the fraction of home heating attributable to the devices present in their home. Table 5 summarizes the respondent device usage estimates normalized by household. For the region as a whole, central oil, wood burning, and direct vent again take precedence (in that order), but the subregions again show some exceptions. Wainwright and University both indicate natural gas as the second most-used heating device. Wainwright also shows a significant amount of district heating, 12.6%, which is substantially higher than in any other sample group. Wood burning device usages are 22.0% and 24.1% in the North Pole and Steese zip codes, respectively, and well above the regional average of 14.8%. Downtown shows the smallest wood device usage fraction at 6.2% of the average household. Portable heating, coal, electric and “other” device types appear to be insignificant contributors to home heating across the region as a whole, with values under 1%. In some zip codes, these devices do show a stronger presence but never exceed 5% of household usage estimates.

**Table 5**  
**2011 Distributions of Respondent-Estimated Winter Heating Usage**  
**Percentages by Device Type**

Heating Device Type	Cell Phone No Zip	Downtown 99701	Wainwright <sup>a</sup> 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Wood Burning	13.4%	6.2%	13.0%	22.0%	15.6%	24.1%	13.3%	<b>14.8%</b>
Central Oil Furnace	54.2%	77.0%	45.7%	69.6%	69.9%	60.4%	65.8%	<b>68.0%</b>
Portable Heat Device	1.3%	1.7%	0.3%	0.8%	0.3%	0.1%	4.2%	<b>0.9%</b>
Direct Vent Type	23.0%	5.2%	6.9%	5.0%	10.1%	10.6%	0.0%	<b>9.2%</b>
Natural Gas	4.7%	3.9%	21.5%	0.9%	1.4%	1.7%	16.7%	<b>3.3%</b>
Coal Heating	0.0%	1.1%	0.0%	0.2%	0.9%	0.3%	0.0%	<b>0.6%</b>
District Heating	2.3%	3.9%	12.6%	0.0%	0.5%	0.1%	0.0%	<b>1.9%</b>
Electric Heating	1.1%	0.4%	0.1%	0.0%	0.7%	0.3%	0.0%	<b>0.5%</b>
Other	0.0%	0.6%	0.0%	1.5%	0.7%	2.4%	0.0%	<b>0.9%</b>

<sup>a</sup> Also includes Birch Hill area

The change in distributions of device usage between 2010 and 2011 is presented in Table 6. The values for cell phone responses, electric heating, and other are not included due to changes in the survey between the two years. The All column does account for cell phone contributions in the 2011 values. Overall, the changes between the two survey years are small (less than 3%) across all devices. The largest difference is a 2.4% drop in the wood burning device usage as estimated by respondents. The standard error for wood burning as reported for the 2010 survey in Table 4-8<sup>1</sup> was  $\pm 2.2\%$  for wood burning devices. Of the remaining devices, only the portable heat devices have a shift (+0.7%) outside of the calculated 2010 standard error ( $\pm 0.3\%$ ).

<sup>1</sup> “2010 Fairbanks Home Heating Survey,” Sierra Research Report No. SR2010-06-01, June 2010.

Individual zip codes show more dramatic shifts between 2010 and 2011 for certain device types. Table 6 highlights those values that exceed the 2010 standard error. For Ft. Wainwright, the -10.5% change in direct vent is outside of the 2010 standard error, where the +7.2% natural gas increase is actually within the standard error. Of most importance, the wood burning usage shifts in North Pole and Airport do appear to be significant changes from 2010. This change in wood burning usage appears to be compensated for by a significant increased central oil usage for those zip codes. The wood burning changes in these zip codes also drive the observed decrease in overall wood burning usage from 2010 to 2011. Due to the small sample size for the University area, the standard error of the 2010 values cannot be calculated.

Heating degree days (HDD) appear to have increased slightly from the 2009-2010 winter season to the 2010-2011 winter. Based on FAI weather data obtained online, as well as a web-based HDD calculation (<http://www.weatherdatadepot.com/#>), the overall HDD value increased by 3.8% in 2011. This brings into question why the wood burning usage values seem to have dropped in 2011, when wood remains one of the most affordable fuel sources as compared to natural gas and central oil. As stated before, the apparent drop in wood usage may in part be attributable to standard error of sampling. Another potential driving force could be the added efficiency of certified stoves, which make up an increasingly large portion of the wood stove population. More efficient stoves require less wood to heat a home than their uncertified counterparts.

Heating Device Type	Downtown 99701	Wainwright <sup>a</sup> 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Wood Burning	-0.60%	3.20%	-6.60%	-4.50%	4.60%	13.30%	-2.40%
Central Oil Furnace	-3.80%	1.40%	6.40%	6.70%	-9.20%	65.80%	0.70%
Portable Heat Device	1.60%	-2.10%	0.80%	0.30%	0.10%	4.20%	0.70%
Direct Vent Type	-1.80%	-10.50%	1.50%	0.40%	0.10%	0.00%	1.00%
Natural Gas	-0.80%	7.20%	-0.70%	-3.00%	1.70%	-83.30%	-1.20%
Coal Heating	1.10%	0.00%	0.10%	-0.60%	0.30%	0.00%	0.10%
District Heating	3.30%	0.90%	-1.60%	0.50%	0.10%	0.00%	0.60%

<sup>a</sup> Also includes Birch Hill area

Note: Yellow highlighting denotes values exceeding the 2010 standard error.

### Wood Burning Device Configurations

The wood burning category is further broken down into the four most commonly used devices, as presented in Table 7. These devices are normalized by household and weighted by the respondents' usage estimates. Wood stoves are clearly the dominant wood burning device in Fairbanks as a whole, at 85% of all wood devices. The individual sample groups show the wood stoves varying between 65.4% and 100% of wood devices. The second most prevalent device varies by the sample subgroups. Outdoor wood boilers showed a 13.0% usage among wood devices in the cell phone

group. Fireplaces with inserts were a significant percentage in Downtown at 19.2% and North Pole at 7.3%.; fireplaces without inserts represented 11.5% of wood devices in Downtown and 16.7% in Wainwright. Wood device usage percentages in other regions fell near or under the regional average.

Wood-Burning Device Type	Cell Phone No Zip	Downtown 99701	Wainwright <sup>a</sup> 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Fireplace	4.3%	11.5%	16.7%	3.6%	5.6%	0.0%	0.0%	<b>5.3%</b>
Fireplace with Insert	0.0%	19.2%	0.0%	7.3%	3.4%	3.7%	0.0%	<b>5.7%</b>
Woodstove	82.6%	65.4%	83.3%	83.6%	89.9%	92.6%	100.0%	<b>85.0%</b>
Outdoor Wood Boiler	13.0%	3.8%	0.0%	5.5%	1.1%	3.7%	0.0%	<b>4.0%</b>

<sup>a</sup> Also includes Birch Hill area

Table 8 reports the certified and un-certified inserts and woodstoves by household. All sample groups show values over 73% certified, with some of the smaller sample groups reporting 100% certified stoves.

Device Type	Cell Phone No Zip	Downtown 99701	Wainwright 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Un-Certified	21.1%	23.8%	0.0%	23.9%	26.6%	12.0%	0.0%	<b>22.4%</b>
Certified	78.9%	76.2%	100.0%	76.1%	73.4%	88.0%	100.0%	<b>77.6%</b>

<sup>a</sup> Also includes Birch Hill area

### Fuel Usage Estimates

Fuel usage and fuel cost estimates were averaged across device-equipped households (not all households but only those reporting usage of the specified device). These fuel use and cost responses are shown in Table 9. Wood usage is significantly higher in the stove/insert category than the fireplace category. This is an interesting result as fireplaces are inherently less efficient at providing heat than stoves/inserts; however, the usage of a fireplace as a primary heating device is far less likely than stoves/inserts. Of 12 respondents with a fireplace, only 3 reported the fireplace as a primary device. After a series of attempted callbacks, only one of the three primary fireplace users reported cord usage for their device (4.00 cords in Downtown). It is possible the average per device would increase significantly with more data from the primary fireplace users.

Device Type & Fuel	Usage Period	Cell Ph No Zip	Dntown 99701	Wnwrght <sup>a</sup> 99703	Nth Pole 99705	Airport 99709	Steese 99712	Univ 99775	All
Stove/Insert Wood Use (cords)	Annual	3.73	2.80	4.60	4.13	3.13	4.48	2.23	<b>3.57</b>
	Winter	3.56	2.50	4.00	3.59	2.82	3.95	2.00	<b>3.19</b>
Fireplace Wood Use (cords)	Annual	1.00	4.00	n/a	n/a	1.33	n/a	n/a	<b>1.80</b>
	Winter	1.00	4.00	n/a	n/a	1.00	n/a	n/a	<b>1.60</b>
Central Oil Use (gal)	Annual	1,225	1,444	1,156	1,207	1,125	1,497	800	<b>1,261</b>
	Winter	803	1,097	940	936	954	1,061	650	<b>977</b>
Portable Heater Fuel Use (gal)	Annual	267	508	40	607	60	118	n/a	<b>253</b>
	Winter	237	358	40	574	53	118	n/a	<b>216</b>
Direct Vent Heater Fuel Use (gal)	Annual	460	421	75	543	337	779	n/a	<b>436</b>
	Winter	400	392	70	488	278	719	n/a	<b>383</b>
Natural Gas Fuel Cost (dollars)	Annual	\$2,275	\$3,900	\$1,725	\$1,267	\$2,300	\$400	n/a	<b>\$2,481</b>
	Winter	\$1,606	\$2,783	\$1,225	\$733	\$1,650	\$400	n/a	<b>\$1,692</b>
District Heat Fuel Cost (dollars)	Annual	\$144	\$1,700	\$229	n/a	\$4,833	\$200	n/a	<b>\$1,727</b>
	Winter	\$105	\$540	\$167	n/a	\$4,667	\$200	n/a	<b>\$1,258</b>

<sup>a</sup> 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)

### BTU-Adjusted Usage Distributions

For devices where fuel and cost estimates were made available, it is possible to calculate the contributions of each device to the total BTUs of households over a season or year. The BTU output of a device over a season is calculated through multiplying device efficiency (BTU/unit fuel) by the fuel used (as estimated by the survey respondent). The average household BTU-adjusted heating fractions are broken down by the zip code and cell phone sample groups in Table 10. The drawback to this approach is a lack of information on the BTU output of electric devices, district heat, and “other” devices. The missing electric device BTU information is unlikely to have a significant impact on the results, assuming the user-estimated usage of 1.1% in the cell phone group is representative of the actual BTU usage. District heating does comprise a significant portion of the overall average device usage for Wainwright at 12.6%. For Downtown, district heating comprises 3.9% of user-estimated usage on average, and 2.4% usage for the cell phone group.

The BTU-adjusted device percentages provide insight on which devices are contributing most to home heating in Fairbanks. Central oil and wood stoves appear to provide the most BTUs per home across Fairbanks as a whole, at 73.08% and 11.5%, respectively; direct vent provides 5.18% of BTUs regionally. Surprisingly, wood boilers are calculated to supply just over 5% of regional heating BTUs (fourth highest). Estimates from respondents about device usage suggested wood boilers were 4% of wood device usage, which themselves comprise under 15% of total heating device usage. For the cell phone and North Pole sample groups, wood boilers represent a far more significant fraction of the heating BTUs at 12.29% and 9.61%.

**Table 10**  
**BTU Adjusted Distributions of Respondent-Estimated Winter Heating**

Heating Fuel Type	Cell Phone No Zip	Downtown 99701	Wainwright <sup>a</sup> 99703	North Pole 99705	Airport 99709	Steese 99712	University 99775	All
Stove Cord	10.42%	3.46%	15.37%	12.63%	15.66%	14.84%	7.56%	<b>11.50%</b>
Stove Pellet	0.50%	0.00%	2.46%	0.06%	0.14%	0.93%	0.00%	<b>0.28%</b>
Insert Cord	0.00%	0.81%	0.00%	1.17%	0.26%	0.67%	0.00%	<b>0.61%</b>
Fireplace	0.00%	0.07%	0.00%	0.00%	0.04%	0.00%	0.00%	<b>0.03%</b>
Wood Boiler	12.29%	1.18%	0.00%	9.61%	3.95%	0.67%	0.00%	<b>5.03%</b>
Central Oil	53.05%	86.39%	67.90%	69.61%	73.96%	70.37%	92.44%	<b>73.08%</b>
Kerosene	2.51%	1.25%	0.59%	3.99%	0.25%	0.62%	0.00%	<b>1.64%</b>
Direct Vent	15.42%	1.68%	2.02%	2.01%	4.84%	11.02%	0.00%	<b>5.18%</b>
Natural Gas	4.85%	4.71%	11.66%	0.60%	0.73%	0.22%	0.00%	<b>2.26%</b>
Coal	0.96%	0.45%	0.00%	0.33%	0.18%	0.67%	0.00%	<b>0.41%</b>

<sup>a</sup> Also includes Birch Hill area

## Conclusions

The 2011 home heating survey continues to show the domination of central oil and wood burning device usage in Fairbanks winters. These trends are consistent across the entire sample region (zip codes), including the randomly selected cell phone response group. The mix of wood burning devices remains consistent, with wood stoves making up the largest share. Wood boilers appear to have increased largely due to their presence in the cell phone and North Pole samples. While central oil usage appears consistent from year to year, the wood burning device sector appears to be more volatile. Considering the increase in home heating days from 2010 to 2011, the decrease in wood burning usage in 2011 is puzzling. There is a clear trend towards more efficient certified wood stove device usage, which may explain some of the decline in fuel usage and perceived device usage.

The addition of a cell phone only response group is a new source of data for the 2011 survey. This randomly sampled group reflects a unique source mix in their home heating practices. Both central oil and wood burning usage fractions are below their regional averages in the cell phone group. Among the wood burning devices used by the respondents in this group, wood boilers represent a significant fraction well above the average (13%). If possible, future surveys may want to query these respondents on their zip code to spatially resolve these devices.