

DATA ANALYSIS AND METHODOLOGY

The objectives of the survey were to determine the quantity of wood consumed and the activity levels of the RWC devices owned by the residents of Washoe County during the 2001-2002 winter season. There were 1,262 Washoe County residents questioned during the survey. Of those 1,262 people, 402 reported burning some type of solid fuel. For each category of RWC device the corresponding percentage of the whole sample population was calculated. This percentage was then multiplied by the estimated total number of dwellings in Washoe County, which for 2001 was 149,460 dwellings. The number derived from this calculation was then considered the 2001 estimate of total number of a specific type of device in the area.

Estimates of the wood-burning devices and wood used in the PM₁₀/CO nonattainment area (NAA) were also calculated. Based on zip code, approximately 928 of the total 1,262 respondents were determined to be within the NAA. Based on that it was determined that approximately 73.5% of the households would be within the NAA. Therefore, 73.5% of 149,460 is 109,904 households in the NAA.

Percentage of Fireplaces:

Countywide respondents reported having 298 fireplaces either as their first, second, or third device. Of the respondents who reported having a fireplace as their first, second, or third device, 40.9% reported actually using them. Within the NAA, respondents reported 257 fireplaces with 40.9% of those actually used.

County Wide:

$$\begin{aligned} 298 \text{ fireplaces} \div 1,262 \text{ respondents} \times 100\% &= 23.6\% \text{ fireplaces} \\ 23.6\% \times 149,460 \text{ households} &= 35,292 \text{ fireplaces} \\ 40.9\% \text{ used} \times 35,292 \text{ fireplaces} &= 14,419 \text{ fireplaces used} \end{aligned}$$

NAA:

$$\begin{aligned} 257 \text{ fireplaces} \div 928 \text{ respondents} \times 100\% &= 27.7\% \text{ fireplaces} \\ 27.7\% \times 109,904 \text{ households} &= 30,437 \text{ fireplaces} \\ 40.9\% \text{ used} \times 30,437 \text{ fireplaces} &= 12,435 \text{ fireplaces used} \end{aligned}$$

Average Wood Consumption for Fireplaces:

Based on the raw data for fireplaces the number of cords burned per device 1, 2 and 3 was on average for fireplaces 0.73 cords/device (NAA – 0.63 cords/device).

Percentage of Woodstoves/Inserts:

Respondents reported having 84 woodstoves or inserts as either their first, second, or third device. Of the respondents who reported having a woodstove/insert as their first,

second, or third device, 71.4% were reported as actually being used. Within the NAA, respondents reported 44 woodstoves or inserts with 61.4% of those actually used.

County Wide:

$84 \text{ woodstove/inserts} \div 1,262 \times \text{respondents} \times 100\% = 6.7\% \text{ woodstove/inserts}$
 $6.7\% \times 149,460 \text{ households} = 9,948 \text{ woodstove/inserts}$
 $71.4\% \text{ used} \times 9,948 \text{ woodstove/inserts} = 7,106 \text{ used}$

NAA:

$44 \text{ woodstove/inserts} \div 928 \text{ respondents} \times 100\% = 4.7\% \text{ woodstove/inserts}$
 $4.7\% \times 109,904 \text{ households} = 5,211 \text{ woodstove/inserts}$
 $61.4\% \text{ used} \times 5,211 \text{ woodstove/inserts} = 3,198 \text{ used}$

Average Wood Consumption for Woodstove/Inserts:

Based on the raw data for woodstove/inserts the number of cords burned per device 1, 2 and 3 on average is 1.79 cords/device (NAA – 1.55 cords/device).

Percentage of Pellet Stoves:

Respondents reported having 31 pellet stoves as either their first, second, or third device. Of the respondents who reported having a pellet stove as their first, second, or third device, 87.1% reported actually using them. Within the NAA, respondents reported 17 pellet stoves with 88.1% of those actually used.

County Wide:

$31 \text{ pellet stoves} \div 1,262 \text{ respondents} \times 100\% = 2.5\% \text{ pellet stoves}$
 $2.5\% \times 149,460 \text{ households} = 3,671 \text{ pellet stoves}$
 $87.1\% \text{ used} \times 3,671 \text{ pellet stoves} = 3,198 \text{ used}$

NAA:

$17 \text{ pellet stoves} \div 928 \text{ respondents} \times 100\% = 1.8\% \text{ pellet stoves}$
 $1.8\% \times 109,904 \text{ households} = 2,013 \text{ pellet stoves}$
 $88.1\% \text{ used} \times 2,013 \text{ pellet stoves} = 1,776 \text{ used}$

The number of pellet stoves sold since 1988 as estimated from WCDHD-AQMD Dealer Affidavits of Sale (DAS) is 1922. The 2001-2002 survey calculated number of 2,013 pellet stoves is greater than the DAS count.

Average Pellet Consumption for Pellet Devices:

Based on the raw data for pellet devices the tons of pellets burned per device 1, 2 and 3. On average is 0.83 tons/device (NAA – 0.61 tons/device).

Estimated Emissions Based on the 2001-2002 Survey

Tables XI and XII list the activity data based on the 2001-2002 Survey for the NAA and the entire County, respectively.

**TABLE XI
2001-2002 NAA Activity Data**

Type of Device	Average cords or tons used per Device	Total # of Units	# of Units Actually Used	Total # of Cords or Tons Used	Average Weight of Wood (lbs./cord)	Total Lbs. of Wood/Yr.
Fireplace	0.63	30,437	12,435	7,834	2,673	20,940,282
Woodstove/Inserts						
Certified	1.55	2,606	1,599	2,478	2,673	6,623,694
Uncertified	1.55	2,606	1,599	2,478	2,673	6,623,694
Wood Totals				12,790		34,187,670
Pellet Stoves	0.61	2,013	1,776	1,083		

**TABLE XII
County Wide Activity Data**

Type of Device	Average cords or tons used per Device	Total # of Units	# of Units Actually Used	Total # of Cords or Tons Used	Average Weight of Wood (lbs./cord)	Total Lbs. of Wood/Yr.
Fireplace	0.73	35,292	14,419	10,526	2,673	28,135,998
Woodstove/Inserts						
Certified	1.79	4,974	3,553	6,360	2,673	17,000,280
Uncertified	1.79	4,974	3,553	6,360	2,673	17,000,280
Wood Totals				23,246		62,136,558
Pellet Stoves	0.83	3,671	3,198	2,654		

The estimated emissions based on the 2001-2002 Survey data are calculated using emission factors from AP-42, Fifth Edition, Sections 1.9 and 1.10 for fireplaces and woodstoves/pellet stoves, respectively. Table XIII gives the estimate for the NAA and Table XIV gives the estimate on the County Wide basis.

**TABLE XIII
2001-2002 NAA ESTIMATED EMISSIONS**

Type of Device	Total tons of wood or pellets/yr.	Emission Factors (lbs./ton)				Emissions (tons/yr.)			
		PM10	CO	NOX	VOC	PM10	CO	NOX	VOC
Fireplaces	10,470	34.6	252.6	2.6	229	181	1,322	14	1,199
Woodstove/Inserts									
Certified	3,312	19.6	104.4	2.0	15	32	173	3	25
Uncertified	3,312	30.6	230.8	2.8	53	51	382	5	88
Total Woodstoves/Inserts						83	555	8	113
Pellet Stoves	1,083	4.2	39.4	13.8	0**	2	21	7	0
*Total Fireplaces + Woodstoves + Pellets (tons/yr.)						266	1,898	29	1,312

*rounded to fewer significant digits

**no data

**TABLE XIV
2001-2002 COUNTY WIDE ESIMATED EMISSIONS**

Type of Device	Total tons of wood or pellets/yr.	Emission Factors (lbs./ton)				Emissions (tons/yr.)			
		PM10	CO	NOX	VOC	PM10	CO	NOX	VOC
Fireplaces	15,217	34.6	252.6	2.6	229	263	1,922	20	1,742
Woodstove/Inserts									
Certified	8,500	19.6	104.4	2.0	15	83	444	9	64
Uncertified	8,500	30.6	230.8	2.8	53	130	981	12	225
Total Woodstoves/Inserts						213	1425	21	289
Pellet Stoves	2,654	4.2	39.4	13.8	0**	6	52	18	0
*Total Fireplaces + Woodstoves + Pellets (tons/yr.)						482	3,399	59	2,031

*rounded to fewer significant digits

**no data

SURVEY COMPARISONS

Tables XV and XVI compares the five recent surveys conducted by the WCDHD-AQMD and MarkeTec.

**TABLE XV
NAA Average RWC Activity**

Device Type	Estimate of Total # of Devices		# of Devices Actually Used		Total # of Cords/Pellets used	
	Estimates	Average*	Estimates	Average*	Estimates	Average*
Fireplaces:		32,442		16,246		0.60
92-93 Survey	33,054		17,684		Unknown	
94-95 Survey	33,336		18,142		0.61	
95-96 Survey	30,179		16,003		0.56	
99-00 Survey	35,205		16,968		0.58	
01-02 Survey	30,437		12,435		0.63	
Woodstove/Inserts		8,308		5,728		1.47
92-93 Survey	9,692		6,784		Unknown	
94-95 Survey	7,564		5,128		1.64	
95-96 Survey	10,015		7,283		1.43	
99-00 Survey	9,056		6,249		1.24	
01-02 Survey	5,211		3,198		1.55	
Pellet Stoves		1,711		1,461		0.84
92-93 Survey	822		712		Unknown	
94-95 Survey	2,179		1,773		0.67	
95-96 Survey	1,560		1,431		1.2	
99-00 Survey	1,981		1,611		0.89	
01-02 Survey	2,013		1,776		0.61	

*rounded to fewer significant digits

TABLE XVI
Washoe County RWC Activity

Device Type	Estimate of Total # of Devices		# of Devices Actually Used		# of Cords/Pellets used per Device	
	Estimates	Average*	Estimates	Average*	Estimates	Average*
Fireplaces:		34,990		17,775		0.72
92-93 Survey	34,431		17,695		0.84	
94-95 Survey	34,047		18,777		0.73	
95-96 Survey	31,701		18,008		0.73	
99-00 Survey	39,479		19,976		0.57	
01-02 Survey	35,292		14,419		0.73	
Woodstove/Inserts		12,043		8,746		1.66
92-93 Survey	13,845		9,573		1.90	
94-95 Survey	10,972		8,031		1.72	
95-96 Survey	13,803		10,640		1.57	
99-00 Survey	11,886		8,380		1.33	
01-02 Survey	9,711		7,106		1.79	
Pellet Stoves		2,555		2,317		1.06
92-93 Survey	1,264		1,264		1.08	
94-95 Survey	3,053		2,939		1.29	
95-96 Survey	2,808		2,574		1.25	
99-00 Survey	1,981		1,611		0.85	
01-02 Survey	3,671		3,198		0.83	

*rounded to fewer significant digits

Some results of the five surveys compare well and some do not. Since there are minor variations because of the methodology, staff elected to use the average activity data from five years' surveys to estimate emissions for emission inventory purposes.

Table XVII summarizes the estimates of average firewood consumption from the last seven woodstove surveys/reports.

TABLE XVII
AVERAGE FIREWOOD CONSUMPTION (cords)*

	1984	1991	1992	1994	1995	1999	2001
Fireplaces	0.91	0.39	0.84	0.73	0.73	0.57	0.73
Stoves/Inserts	2.25	1.24	1.90	1.72	1.57	1.33	1.79
Total cords	38,593	20,305	34,673	27,521	29,851	22,530	23,246

*Based on devices reported used

ESTIMATED EMISSIONS

Tables XVIII and XIX list the activity data for the NAA and the entire County based on the average of the data collected from the last three surveys.

**TABLE XVIII
Average NAA Activity Data**

Type of Device	Average Cords or tons used per Device	Total # of Units	# of Units Actually Used	Total # of Cords or Tons Used	Average Weight of Wood (lbs./cord)	Total Lbs. of Wood/Yr.
Fireplace	0.60	32,442	16,246	9,748	2,673	26,056,404
Woodstove/Inserts						
Certified	1.47	4,154	2,864	4,210	2,673	11,253,330
Uncertified	1.47	4,154	2,864	4,210	2,673	11,253,330
Wood Totals				18,168	-	48,563,064
Pellet Stoves	0.84	1,711	1,461	1,227	-	-

**TABLE XIX
Average County Wide Activity Data**

Type of Device	Average cords or tons used per Device	Total # of Units	# of Units Actually Used	Total # of Cords or Tons Used	Average Weight of Wood (lbs./cord)	Total Lbs. of Wood/Yr.
Fireplace	0.72	34,990	17,775	12,798	2,673	34,209,054
Woodstove/Inserts						
Certified	1.66	6,022	4,373	7,259	2,673	19,403,307
Uncertified	1.66	6,022	4,373	7,259	2,673	19,403,307
Wood Totals				27,316	-	73,015,668
Pellet Stoves	1.06	2,555	2,317	2,456	-	-

The estimated emissions based on the average survey data are calculated using AP-42, Fifth Edition, emission factors. Table XX gives the estimate for the NAA and Table XXI gives the estimate on the County Wide basis.

**TABLE XX
NAA ESTIMATED EMISSIONS BASED ON AVERAGED ACTIVITY DATA**

Type of Device	Total tons of wood or pellets/yr.	Emission Factors (lbs./ton)				Emissions (tons/yr.)			
		PM ₁₀	CO	NO _x	VOC	PM ₁₀	CO	NO _x	VOC
Fireplaces	13,028	34.6	252.6	2.6	229	225	1,645	17	1,492
Woodstove/Inserts									
Certified	5,627	19.6	104.4	2.0	15	55	294	6	42
Uncertified	5,627	30.6	230.8	2.8	53	86	649	8	149
Total Woodstoves/Inserts						366	2,588	31	1,683
Pellet Stoves	1,227	4.2	39.4	13.8	0**	3	24	8	0
*Total Fireplaces + Woodstoves + Pellets (tons/yr.)						594	4,257	56	3,175

*rounded to fewer significant digits

**no data

**TABLE XXI
COUNTY WIDE ESTIMATED EMISSIONS BASED ON AVERAGED ACTIVITY DATA**

Type of Device	Total tons of wood or pellets/yr.	Emission Factors (lbs./ton)				Emissions (tons/yr.)			
		PM ₁₀	CO	NO _x	VOC	PM ₁₀	CO	NO _x	VOC
Fireplaces	17,105	34.6	252.6	2.6	229	296	2,160	22	1,959
Woodstove/Inserts									
Certified	9,702	19.6	104.4	2.0	15	95	506	10	73
Uncertified	9,702	30.6	230.8	2.8	53	148	1,120	14	257
Total Woodstoves/Inserts						539	3,786	46	2,289
Pellet Stoves	2,456	4.2	39.4	13.8	0**	5	48	17	0
*Total Fireplaces + Woodstoves + Pellets (tons/yr.)						840	5,994	85	4,248

*rounded to fewer significant digits

**no data

SUMMARY

Residential wood combustion (RWC) is a significant source of air pollution in Washoe County. RWC emissions have been directly linked to monitored violations of the national ambient air quality standards. It is therefore important that we quantify and characterize this emission source to the best of our abilities in order to develop appropriate preventative and mitigative measures.

This RWC report represents the fifth in a series of annual professionally administered surveys. The establishment of a consistent survey instrument and the comparison of socioeconomic data with other agency surveys have allowed the District staff to achieve a high degree of confidence in the results. Some highlights of the five surveys:

- In Washoe County, there are approximately 35,000 fireplaces, 12,000 woodstoves/inserts, and 2,600 pellet stoves.
- The surveys indicate that only about one-half (51%) of the fireplaces, and three-quarters (73%) of the woodstoves/inserts, are actually used. Virtually all of the pellet devices are used on a regular basis.
- Approximately 58% of the woodstoves/inserts were described as nine (9) or more years old and therefore are uncertified and assumed to have high emission rates.
- The number of wood burning devices has remained relatively flat over the ten-year survey period, despite an over 25% increase in population. The exception has been pellet stoves; their number has doubled over the same period. Natural gas-fired appliances are not accounted for in this survey because they do not contribute significantly to carbon monoxide or particulate air pollution.
- The Red-Yellow-Green curtailment program maintains a high level of public awareness (88%) and compliance (76%); however these numbers are down slightly from previous surveys probably because we have not done a media campaign addressing this program.

The 2001-2002 survey indicated a slight increase in firewood consumption as compared to the 1999-2000 survey. This increase is probably caused by the higher cost of heating fuel other than firewood. However, the overall surveys from 1992 through 2001 indicate a declining trend in residential wood stove emissions in Washoe County. This reduction has been reflected in the improved ambient air quality monitored in Washoe County over the last few years. Staff will contract another survey within the next few years to determine trends in solid fuel burning.