

Summary: PM_{2.5} Nonattainment Process

The National Ambient Air Quality Standard (NAAQS) and Nonattainment Designation for PM_{2.5}

- EPA adopted a revised 24-hour PM_{2.5} standard from 65 ug/m³ to 35 ug/m³ in 2006.
- A violation of the 24 hr standard occurs if the three-year average of the 98th percentile value exceeds 35 micrograms. This is an issue for some areas in Washington State.
- The EPA did not change the annual standard of 15 ug/m³. Meeting the annual standard is not an issue in Washington State.
- December 18, 2007: states must submit their recommendations to EPA on what areas EPA should designate as attainment or nonattainment. For Washington State, the recommendation is made by the Director of Ecology on behalf of the Governor.
- December 18, 2008: EPA makes the final decision on what areas are designated nonattainment.
- Compliance with the PM_{2.5} standard is determined by data from the filter-based Federal Reference Monitors (FRMs).
 - Ecology uses other kinds of monitoring methods for evaluation and analysis but they are not certified by EPA for use in determining compliance with the NAAQS.
- Ecology's recommendation on nonattainment also includes a recommended boundary for the nonattainment area. In large urban areas this is not a trivial task.
- Once an area is designated as a nonattainment area, the state has three years to develop a nonattainment plan. The nonattainment plan outlines the methods that will be used to reduce the PM_{2.5} emissions to a level that no longer exceeds the standard.

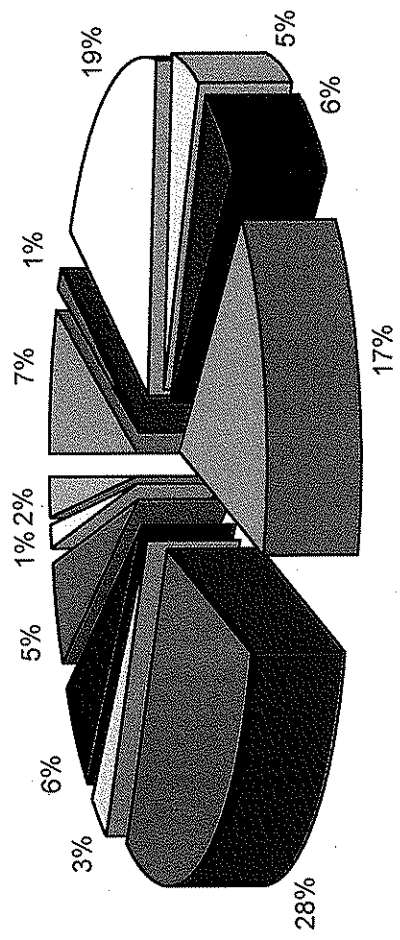
Specific Areas of Concern in Washington State

- South Tacoma: based on 2004-2006 FRM monitoring at L-Street, this area violates the standard and will be part of a nonattainment area.
- Yakima: FRM data from 2000 to 2004 indicates that Yakima probably violates the standard. More recent data shows that the area exceeds the standard, but it is not FRM data. An FRM was reestablished in 2007.
- Darrington: It also has monitoring data that exceed the standard, but not from an FRM monitor.

Health concerns

- Even though EPA set the standard at 35 ug/m³, health data clearly shows impacts at well below that level.
- Ecology's policy is to try to keep PM_{2.5} levels below 20 ug/m³.

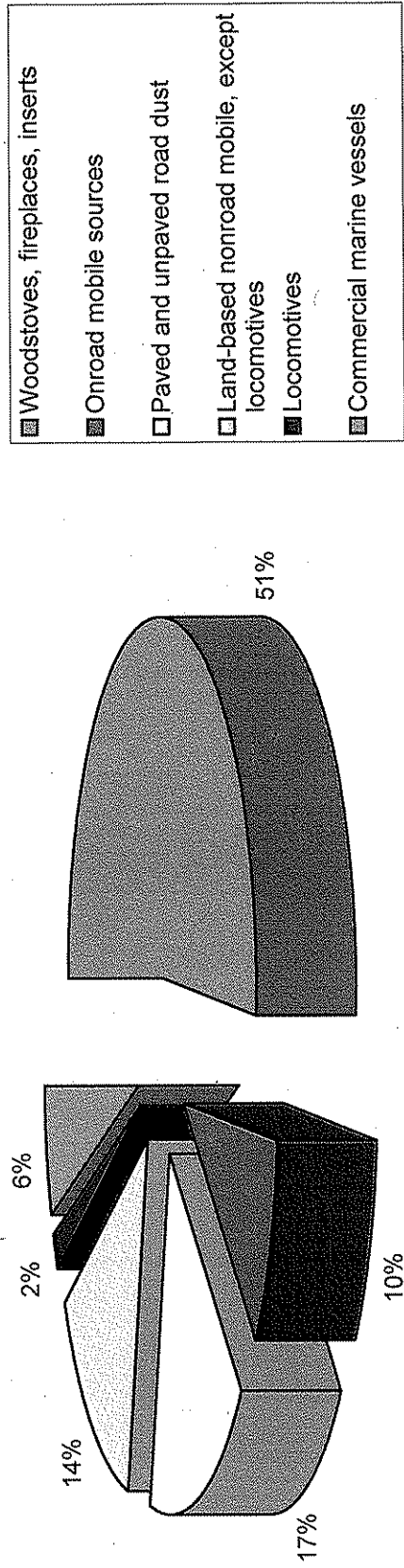
Annual Statewide Emissions Sources for PM 2.5
(Data source: Washington State Base Year 2005 County Inventories)



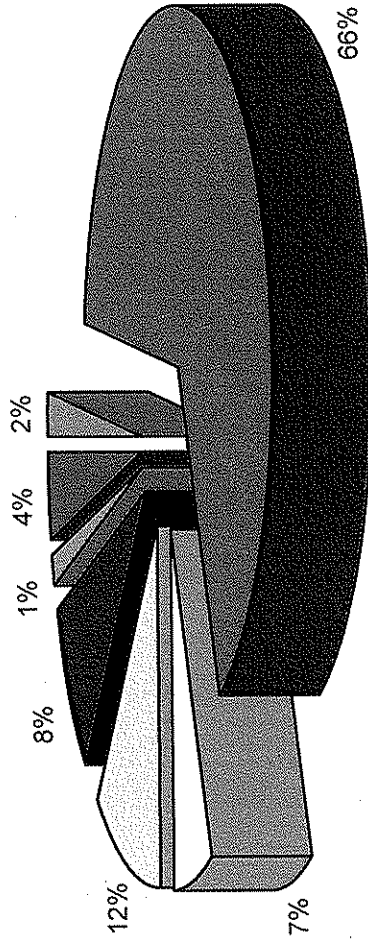
- Point sources
- Small point sources treated as area sources
- Woodstoves, fireplaces, inserts
- Agricultural, silvicultural, and rangeland burning
- Residential outdoor burning: yard waste, trash
- Agricultural tilling and harvesting
- Wildfires, structure and vehicle fires
- Onroad mobile sources
- Paved and unpaved road dust
- Land-based nonroad mobile, except locomotives
- Locomotives
- Commercial marine vessels

Other sources of PM 2.5 were Other sources of PM 2.5 were looked at and were determined to be insignificant (produced less than 1% of the total PM 2.5 emissions) or did not emit PM 2.5.
 6/22/2007

**Sources of Annual Statewide Emissions Sources for PM 2.5
(excluding agricultural sources, wildfires, structural fires, vehicle fires, vehicle fires, prescribed burning,
and residential outdoor burning)**



**Sources of Annual Statewide Emissions Sources for PM 2.5 from December to February
(excluding agricultural sources, wildfires, structural fires, vehicle fires, vehicle fires, prescribed burning,
and residential outdoor burning)**



- Residential fuel use: natural gas, oil, LPG
- Woodstoves, fireplaces, inserts
- Onroad mobile sources
- Paved and unpaved road dust
- Land-based nonroad mobile, except locomotives
- Locomotives
- Commercial marine vessels

**Key Points about the “Excerpts from Washington State
Base Year 2005 Counties Inventories” Document**

- Emissions inventories are used for numerous reasons including: non-regulatory planning, regulatory planning, air quality forecasting, public information, and to meet federal air quality reporting requirements.
- This document contains excerpts regarding residential wood burning. Detailed information regarding other types of emissions and emission sources has been left out.
- This inventory contains emission totals at the county level and statewide level, rather than the community level.
- There are differences between incorporated areas of the state, Eastern Washington where there are forests, Eastern Washington where there are no forests, and Western Washington regarding ownership by device type and device usage.
- Seasonal burning habits are also identified by incorporated areas of the state, Eastern Washington where there are forests, Eastern Washington where there are no forests, and Western Washington.

1 Introduction

1.1 Purpose and Background

An emissions inventory is part of an overall air quality management program. Emissions inventories are used in SIP attainment/maintenance planning, air quality forecasting, other air quality planning and rule efforts, public information, point source fee generation, and to meet federal air quality reporting requirements. A complete emissions inventory contains emissions from point, area, mobile and biogenic sources of air pollution.

This document describes the methods and data sources employed to estimate emissions for base year 2005. Emissions were estimated for criteria pollutants, ammonia, and toxic air pollutants as resources allowed. The 2005 inventory will be used to update the AIRQUEST-sponsored AIRPACT air quality forecasting system inventory, fulfill federal reporting requirements, and to support many other end uses over the next three years.

The 2005 inventory joins two prior comprehensive inventories prepared for base years 1996 and 2002. These inventories were also multi-purpose inventories, fulfilling federal reporting requirements, and supporting state and local air quality program goals. The 2002 inventory was the first inventory submitted to EPA under the Consolidated Emissions Reporting rule published in 2002 (40 CFR 51.1 - 51.45). The rule requires comprehensive inventories be completed every three years beginning with base year 2002.

Care should be taken if comparing results from the three inventories. What appear to be emissions changes may instead reflect 1) changes in emissions estimation models, methodologies, and /or emission rates, 2) sources and/or pollutants included in the inventory, and 3) correction of errors in prior inventories. A separate document will be prepared comparing the 2005 and 2002 inventories, noting these considerations.

1.2 Spatial Resolution

The inventory was developed at the county level.

1.3 Temporal Resolution

The inventory was developed for each of the four seasons, and the annual total. Generally, Dec-Feb was classified as winter, Mar-May as spring, Jun-Aug as summer and Sep-Nov as fall.

Abbreviations used are tpy (tons per year) and tps (tons per season).

2 Statistics Used Throughout the Inventory

2.1 County Demographics

Emissions estimation methods for many source categories rely on surrogate parameters as indicators of activity. Population and housing units are two of the most common. The 2000 Census provided data for population, occupied housing units, and heat source (four shown here).¹

Population for 2005 was available through the State Office of Financial Management.² The county ratios of 2005 to 2000 population were used to project occupied housing units and heat source. The results are shown in Table 2-1.

Table 2-1: Population and Housing, 2005

county	Population			Total	Occupied Housing Units			Heat Source (Occupied Housing Units)			
	Incorp	Unincorp	Total		Incorp	Unincorp	Total	Natural Gas	LPG	Oil	Coal
Adams	8,770	8,230	17,000	2,791	2,620	5,411	1,517	103	458	0	
Asotin	8,410	12,490	20,900	3,423	5,083	8,506	5,251	258	340	0	
Benton	122,025	36,075	158,100	45,278	13,386	58,664	4,960	522	911	0	
Chelan	39,215	29,985	69,200	14,729	11,262	25,991	819	162	469	0	
Clallam	26,495	40,305	66,800	11,154	16,968	28,122	53	923	630	0	
Clark	202,545	188,955	391,500	74,631	69,623	144,254	33,664	1,022	3,361	0	
Columbia	2,845	1,255	4,100	1,181	521	1,702	4	66	608	4	
Cowlitz	55,910	40,290	96,200	21,449	15,540	36,989	1,476	288	564	0	
Douglas	12,920	21,780	34,700	4,647	7,833	12,480	193	62	194	0	
Ferry	975	6,425	7,400	379	2,498	2,877	8	173	190	0	
Franklin	48,045	12,455	60,500	14,448	3,746	18,194	1,738	179	492	0	
Garfield	1,515	885	2,400	624	364	988	0	119	223	0	
Grant	41,440	37,660	79,100	13,982	12,707	26,689	445	149	136	13	
Grays Harbor	42,295	27,505	69,800	16,874	10,974	27,848	3,053	1,109	1,230	5	
Island	24,550	51,450	76,000	9,532	19,977	29,509	3,480	5,459	1,451	0	
Jefferson	8,745	18,855	27,600	3,924	8,460	12,384	44	2,048	959	0	
King	1,443,802	364,498	1,808,300	590,905	149,178	740,083	318,751	10,220	60,851	60	
Kitsap	72,480	167,920	240,400	27,001	62,556	89,557	22,223	4,684	8,437	7	
Kittitas	21,225	15,375	36,600	8,514	6,167	14,681	2,631	2,021	1,002	10	
Klickitat	6,540	12,960	19,500	2,551	5,055	7,606	1,443	308	444	0	
Lewis	28,387	43,213	71,600	10,886	16,571	27,457	3,420	1,238	668	42	
Lincoln	5,630	4,470	10,100	2,295	1,822	4,117	1,021	183	779	4	
Mason	8,735	43,165	51,900	3,344	16,523	19,867	1,432	1,769	587	7	
Okanogan	15,730	23,870	39,600	5,974	9,066	15,040	55	360	526	0	
Pacific	7,100	14,200	21,300	3,078	6,155	9,233	31	559	482	0	
Pend Oreille	2,990	9,210	12,200	1,182	3,642	4,824	9	179	50	0	
Pierce	409,960	345,940	755,900	152,561	128,737	281,298	95,092	6,009	11,939	44	
San Juan	2,150	13,350	15,500	988	6,132	7,120	52	838	730	0	
Skagit	63,650	47,250	110,900	24,014	17,827	41,841	17,791	4,755	1,648	0	
Skamania	2,001	8,299	10,300	761	3,157	3,918	458	186	118	2	
Snohomish	340,410	315,390	655,800	126,302	117,019	243,321	79,609	8,448	6,460	17	
Spokane	314,452	121,848	436,300	123,039	47,700	170,739	89,546	2,579	12,661	116	
Stevens	9,579	31,621	41,200	3,890	11,852	15,742	3,655	1,110	764	23	
Thurston	97,650	126,450	224,100	38,440	49,777	88,217	30,739	4,710	2,876	9	
Wahkiakum	550	3,350	3,900	223	1,360	1,583	3	155	132	0	
Walla Walla	40,865	16,635	57,500	14,550	5,923	20,473	8,224	290	1,637	7	
Whatcom	100,952	79,848	180,800	39,001	30,848	69,849	31,431	8,067	2,077	2	
Whitman	36,040	6,360	42,400	13,497	2,382	15,879	5,391	269	1,340	22	
Yakima	140,240	89,060	229,300	46,620	29,606	76,226	20,343	2,386	4,789	103	
State Total	3,817,518	2,438,882	6,256,400	1,478,422	930,617	2,409,039	790,555	73,965	133,203	497	

2.2 Residential Yard Waste Burning

Residential yard waste burning is outdoor burning of vegetative material.

2.2.1 Activity Level and Spatial Allocation

The measure of activity for residential yard waste burning is the amount of material burned. In 2001, Washington State University under contract to the Idaho Department of Environmental Quality conducted a telephone survey of wood heating and outdoor burning habits in Idaho, Oregon and Washington.³ The survey included questions to estimate the fraction of households that burned yard waste and the number of legal size piles (4') burned per household per year. In Washington, the survey defined four geographic groups in Washington: 1) incorporated cities, 2) unincorporated western WA, 3) unincorporated eastern WA with forest lands, and 4) unincorporated eastern WA without forest lands. Each county's incorporated areas were assigned to the first group. Unincorporated areas were assigned to one of the last three groups. An estimate of the number of households in each county may be found in Table 2-1.

County unincorporated area assignments were:

western WA: Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, King, Kitsap, Lewis, Mason, Pacific, Pierce, San Juan, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, Whatcom

eastern WA w/forest: Chelan, Columbia, Douglas, Ferry, Kittitas, Klickitat, Okanogan, Pend Oreille, Spokane, Stevens, Walla Walla, Yakima

eastern WA w/o forest. Adams, Asotin, Benton, Franklin, Garfield, Grant, Lincoln, Whitman

2.3 Residential Wood Combustion

Residential wood combustion consists of home heating and recreational use of woodstoves, fireplaces, fireplace inserts and central furnaces.

During development of the 2005 inventory, an error was identified in the survey reduction process that had been used for prior projects including the 2002 base year inventory. The error resulted in overestimated emissions on the order of 2x. Emission factors were updated to those used by EPA in their final 2002 inventory. This update resulted in reduced emissions for several pollutants:

2.3.1 Activity Level

The measure of activity for residential wood combustion is the amount of wood burned. The Washington State University telephone survey of wood heating and outdoor burning habits in Idaho, Oregon and Washington described in section 2.2 included questions to estimate the number of households using each type of device (Central Furnace, Certified (Phase I, Phase II) and Non-certified Inserts and Woodstoves, and Fireplaces); how much wood was burned per device; and seasonal, daily and hourly usage rates. The geographic subgroups, county assignments, and number of households in each subgroup were the same as in section 2.2. The fractions of households owning and using wood

burning devices are shown in the tables below. The ownership table is shown for information only. The usage rates in Table 2-4 are used in activity level calculations.

Table 2-2: Wood Burning Device Ownership

Device Type	Incorporated	E WA w/forest	E WA w/o forest	W WA
Central Furnace	0.013	0.012	0.000	0.000
Fireplaces	0.381	0.161	0.185	0.150
Non-certified Insert	0.039	0.048	0.033	0.058
Certified Insert, Phase I	0.000	0.000	0.000	0.006
Certified Insert, Phase II	0.067	0.039	0.021	0.043
Non-certified Pellet stove	0.017	0.042	0.036	0.043
Certified Pellet stove, 1988 stds	0.004	0.000	0.008	0.006
Non-certified Woodstove	0.039	0.073	0.045	0.126
Certified Woodstove, Phase I	0.000	0.024	0.000	0.006
Certified Woodstove, Phase II	0.032	0.036	0.020	0.058
Total Equipment	0.591	0.436	0.347	0.497

Table 2-3: Wood Burning Device Usage

Device Type	Incorporated	E WA w/forest	E WA w/o forest	W WA
Central Furnace	0.009	0.012	0.000	0.000
Fireplaces	0.248	0.106	0.086	0.071
Non-certified Insert	0.025	0.027	0.012	0.058
Certified Insert, Phase I	0.000	0.000	0.000	0.006
Certified Insert, Phase II	0.044	0.024	0.018	0.043
Non-certified Pellet stove	0.013	0.036	0.036	0.043
Certified Pellet stove, 1988 stds	0.004	0.000	0.008	0.006
Non-certified Woodstove	0.035	0.055	0.030	0.113
Certified Woodstove, Phase I	0.000	0.024	0.000	0.006
Certified Woodstove, Phase II	0.031	0.036	0.020	0.052
Total Equipment	0.409	0.321	0.210	0.399

The WSU survey gathered information on pellets, presto logs and cords of wood burned. A cord contains 128 ft³ (4' x 4' x 8'). The solid volume may range from 60-100 ft³. An average solid volume of 85 ft³ was used in this inventory.^{4, 5} The weight of a cord of wood varies with moisture content and species type. It was assumed that moisture content was 20% (legal moisture limit).⁶ Species type was defined using several sources. In a 1985 survey done by Market Trends, Inc.,⁷ species burned were identified for western and eastern Washington. The survey was used to identify species for western Washington, but Ecology, Department of Natural Resources (DNR), and US Forest Service (USFS) staff all agreed that the species allocations for eastern Washington had changed somewhat, so their recommendations were used.⁸ Average weight of a cord of seasoned wood in eastern Washington was 2788 lbs and 2607 lbs in western Washington (2230 and 2086 lb/cord dry weight, respectively).

Table 2-4: Wood Species Weight⁴ and Percent Use by Area

Species	lb/cord (seasoned)*	lb/cord (dry)*	% use WWA	% use EWA
Alder	2,540	2,032	56	
Cedar	2,060	1,648	4	
Cottonwood	2,160	1,728	4	
Douglas Fir	2,970	2,376	16.5	25
Hemlock	2,700	2,160	16.5	
Larch	3,330	2,664		25
Lodgepole Pine	2,610	2,088		25
Madrona	4,320	3,456	1	
Oak	3,680	2,944	1	
Ponderosa Pine	2,240	1,792		25

* seasoned = 20% moisture, dry = 0% moisture

The WSU survey provided information on the number of cords burned per device. Pellets used were given in number of 40 lb bags used, and presto logs as number of logs burned. A presto log manufacturer in Spokane estimated the weight of a log as 8 lbs. The total numbers of tons burned by device type are shown in Table 2-5.

Table 2-5: Tons Burned* per Wood Burning Device

Device Type	Incorporated		Unincorporated		
	E WA	W WA	E WA w/forest	E WA w/o forest	W WA
Central Furnaces	0.7	0.7	**10.5	0.0	0.0
Fireplaces	0.6	0.6	0.4	1.0	0.8
Inserts	1.8	1.7	2.4	1.7	2.5
Pellet stoves	1.8	1.8	2.4	2.0	0.9
Woodstoves	2.5	2.4	3.8	1.9	3.8

* Assuming 20% moisture for cord wood

** actual survey value; already removed outliers

Table 2-6: Residential Wood Combustion Seasoned Tons Burned*

County	CF	FP	PWS	WS&INS-C	WS&INS-UC	Total
Adams	18	648	320	624	576	2,186
Asotin	22	961	560	896	853	3,292
Benton	287	7,929	2,580	8,092	7,064	25,953
Chelan	1,521	2,717	1,446	5,561	5,010	16,255
Clallam	66	2,495	1,086	7,508	11,178	22,334
Clark	443	14,276	5,315	35,083	49,457	104,575
Columbia	74	200	82	336	298	990
Cowlitz	127	3,857	1,329	8,540	11,635	25,488
Douglas	1,022	1,057	835	2,983	2,741	8,638
Ferry	319	173	233	777	728	2,229
Franklin	92	2,484	776	2,546	2,213	8,110
Garfield	4	125	52	124	111	416
Grant	89	3,209	1,566	3,096	2,854	10,815
Grays Harbor	100	2,965	990	6,287	8,431	18,773
Island	57	2,434	1,172	8,306	12,713	24,682
Jefferson	23	1,015	493	3,501	5,370	10,402
King	3,505	90,871	24,188	139,022	159,587	417,174
Kitsap	160	7,225	3,586	25,588	39,454	76,014
Kittitas	836	1,555	806	3,116	2,803	9,115
Klickitat	657	615	525	1,854	1,709	5,361
Lewis	65	2,436	1,061	7,331	10,916	21,809
Lincoln	15	503	233	490	448	1,689
Mason	20	1,379	835	6,198	9,950	18,380
Okanogan	1,187	1,312	985	3,546	3,252	10,281
Pacific	18	770	365	2,580	3,934	7,668
Pend Oreille	469	346	359	1,232	1,145	3,550
Pierce	905	28,435	10,260	67,029	93,261	199,890
San Juan	6	476	302	2,263	3,661	6,708
Skagit	142	4,341	1,507	9,710	13,274	28,974
Skamania	5	280	163	1,202	1,916	3,567
Snohomish	749	24,116	8,959	59,095	83,233	176,152
Spokane	6,825	20,550	7,974	33,153	29,282	97,785
Stevens	1,525	1,086	1,159	3,969	3,690	11,430
Thurston	228	8,120	3,357	22,873	33,504	68,082
Wahkiakum	1	106	67	502	812	1,489
Walla Walla	843	2,442	968	4,000	3,538	11,792
Whatcom	231	7,155	2,531	16,424	22,651	48,993
Whitman	86	2,221	625	2,300	1,979	7,211
Yakima	4,047	8,320	4,042	15,868	14,219	46,496
State Total	26,786	261,208	93,695	523,604	659,454	1,564,746

CF = central furnace, FP = fireplace, PWS = pellet stove,
 WS&INS-C = certified woodstoves/inserts, WS&INS-UC = uncertified woodstoves/inserts

* Assuming 20% moisture for seasoned cord wood

2.3.2 Emission Rates

Criteria and toxic pollutant emission factors in pounds of pollutant per ton of wood burned were taken from AP42 and an EPA report as referenced in the documentation of the 2002 National Emissions Inventory.^{9, 10, 11} Certified stoves and inserts were assumed to be 28.75% catalytic and 71.25% non-catalytic per the 2002 NEI documentation.¹² Estimates of PM_{2.5} from pellet stoves were made using PM size distributions from the California Air Resources Board (PM profile #424 Fireplaces and

Woodstoves: PM10 = 0.935, PM2.5 = 0.9001).¹¹ The emission rates are based on dry (0% moisture) wood; therefore, the cord wood amounts shown in Table 2-6 must be reduced by 20% when calculating emissions. Because presto logs and pellets have very low moisture and their amounts were not adjusted in emissions calculations.

Table 2-7: Criteria Pollutant Emission Factors in Pounds per Ton Burned*

Equipment Type	PM ₁₀	PM _{2.5}	SO ₂	NO _x	VOC	CO
Central Furnace	30.6	30.6	0.4	2.8	53	230.8
Fireplaces	23.6	23.6	0.4	2.6	**229	128
Non-certified Insert	30.6	30.6	0.4	2.8	53	230.8
Certified Insert, Non-catalytic Phase I	20	20	0.4	2	12	140.8
Certified Insert, Non-catalytic Phase II	14.6	14.6	0.4	2	12	140.8
Certified Insert, Catalytic Phase I	19.6	19.6	0.4	2	15	104.4
Certified Insert, Catalytic Phase II	16.2	16.2	0.4	2	15	107
Non-certified Pellet stove	8.8	8.5	0.4	13.8	13.5	52.2
Certified Pellet stove, 1988 stds	4.2	4	0.4	13.8	13.5	39.4
Non-certified Woodstove	30.6	30.6	0.4	2.8	53	230.8
Certified Woodstove, Non-catalytic Phase I	20	20	0.4	2	12	140.8
Certified Woodstove, Non-catalytic Phase II	14.6	14.6	0.4	2	12	140.8
Certified Woodstove, Catalytic Phase I	19.6	19.6	0.4	2	15	104.4
Certified Woodstove, Catalytic Phase II	16.2	16.2	0.4	2	15	107

* 0% moisture

** verified by EPA

Criteria Pollutant	Description
CO	Carbon Monoxide
NH ₃	Ammonia
NO _x	Nitrogen Oxides
PM ₁₀	Particulate Matter less than or equal to 10 micrometers in diameter
PM _{2.5}	Particulate Matter less than or equal to 2.5 micrometers in diameter
DP _{M2.5}	Diesel Particulate Matter less than or equal to 2.5 micrometers in diameter
SO ₂	Sulfur Dioxide
VOC	Volatile Organic Compounds
VOC w/o NAT	Volatile Organic Compounds without natural emissions from soil and vegetation

Table 2-8: Toxics Emission Factors in Pounds per Tons Burned*

Pollutant	NEI code	fireplace	stoves/inserts/furnaces					pellet stoves
			uncert.	cert pl non-catalytic	cert pl catalytic	cert pli non-cat	cert pli catalytic	
1,2,3,4,6,7,8-heptachlorodibenzofuran	67562394	3.00E-10	3.00E-10	3.00E-10	3.00E-10	3.00E-10	3.00E-10	
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	35822469	3.16E-10	3.16E-10	3.16E-10	3.16E-10	3.16E-10	3.16E-10	
1,2,3,4,7,8,9-heptachlorodibenzofuran	55673897	2.34E-10	2.34E-10	2.34E-10	2.34E-10	2.34E-10	2.34E-10	
1,2,3,4,7,8-hexachlorodibenzofuran	70648269	3.56E-10	3.56E-10	3.56E-10	3.56E-10	3.56E-10	3.56E-10	
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	39227286	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	
1,2,3,6,7,8-hexachlorodibenzofuran	57117449	2.20E-10	2.20E-10	2.20E-10	2.20E-10	2.20E-10	2.20E-10	
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	57653857	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	
1,2,3,7,8,9-hexachlorodibenzofuran	72918219	1.98E-10	1.98E-10	1.98E-10	1.98E-10	1.98E-10	1.98E-10	
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	19408743	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	
1,2,3,7,8-pentachlorodibenzofuran	57117416	4.56E-10	4.56E-10	4.56E-10	4.56E-10	4.56E-10	4.56E-10	

Pollutant	NEI code	fireplace	stoves/inserts/furnaces					pellet stoves
			uncert.	cert pl non-catalytic	cert pl catalytic	cert pll non-cat	cert pll catalytic	
1,2,3,7,8-pentachlorodibenzo-p-dioxin	40321764	2.58E-10	2.58E-10	2.58E-10	2.58E-10	2.58E-10	2.58E-10	
2,3,4,6,7,8-hexachlorodibenzofuran	60851345	1.65E-10	1.65E-10	3.30E-10	1.65E-10	1.65E-10	1.65E-10	
2,3,4,7,8-pentachlorodibenzofuran	57117314	6.44E-10	6.44E-10	1.29E-09	6.44E-10	6.44E-10	6.44E-10	
2,3,7,8-tetrachlorodibenzofuran	51207319	1.25E-09	1.25E-09	2.50E-09	1.25E-09	1.25E-09	1.25E-09	
2,3,7,8-tetrachlorodibenzo-p-dioxin	1746016	2.28E-10	2.28E-10	4.56E-10	2.28E-10	2.28E-10	2.28E-10	
7,12-Dimethyl/benz(a)anthracene	57976			1.62E-03		1.62E-03		
Acenaphthene	83329		6.21E-03	4.04E-03	3.08E-03	4.04E-03	3.08E-03	
Acenaphthylene	208968		1.32E-01	1.29E-02	3.49E-02	1.29E-02	3.49E-02	
Anthracene	120127		8.69E-03	3.64E-03	4.10E-03	3.64E-03	4.10E-03	
Benz(a)anthracene	56553		1.24E-02		1.23E-02		1.23E-02	
Benzene	71432		1.94E+00		1.46E+00		1.46E+00	
Benzo(a)pyrene	50328		2.48E-03	2.42E-03	2.05E-03	2.42E-03	2.05E-03	
Benzo(b)fluoranthene	205992		3.73E-03	1.62E-03	2.05E-03	1.62E-03	2.05E-03	
Benzo(e)pyrene	192972		7.45E-03	8.08E-04	2.05E-03	8.08E-04	2.05E-03	
Benzo(g,h,i)Fluoranthene	203123			1.13E-02	3.08E-03	1.13E-02	3.08E-03	
Benzo(g,h,i)perylene	191242		2.48E-03	8.08E-03	1.03E-03	8.08E-03	1.03E-03	
Benzo(k)fluoranthene	207089		1.24E-03		1.03E-03		1.03E-03	
Benzo(b)fluoranthene	205992							2.60E-05
Biphenyl	92524			8.89E-03		8.89E-03		
Cadmium	7440439		2.20E-05	2.00E-05		2.00E-05		
Chrysene	218019		7.45E-03	4.04E-03	5.13E-03	4.04E-03	5.13E-03	7.52E-05
Dibenzo(a,h)anthracene	53703			1.62E-03	1.03E-03	1.62E-03	1.03E-03	
Fluoranthene	206440		1.24E-02	3.23E-03	6.16E-03	3.23E-03	6.16E-03	5.48E-05
Fluorene	86737		1.49E-02	5.66E-03	7.18E-03	5.66E-03	7.18E-03	
Indeno(1,2,3-cd)pyrene	193395			8.08E-03	2.05E-03	8.08E-03	2.05E-03	
Manganese	7439965		1.70E-04	1.40E-04		1.40E-04		
Methyl Ethyl Ketone	78933		2.90E-01		6.20E-02		6.20E-02	
Naphthalene	91203		1.79E-01	5.82E-02	9.54E-02	5.82E-02	9.54E-02	
Nickel	7440020		1.40E-05	2.00E-05		2.00E-05		
Octachlorodibenzofuran	39001020	1.67E-10	1.67E-10	3.33E-10	1.67E-10	1.67E-10	1.67E-10	
Octachlorodibenzo-p-dioxin	3268879	6.66E-10	6.66E-10	1.33E-09	6.66E-10	6.66E-10	6.66E-10	
O-xylene	95476		2.02E-01		1.86E-01		1.86E-01	
Perylene	198550			8.08E-04		8.08E-04		
Phenanthrene	85018		4.84E-02	4.77E-02	2.46E-02	4.77E-02	2.46E-02	3.32E-05
Polycyclic Organic Matter	246	1.60E-03						
Pyrene	129000		1.49E-02	3.23E-03	5.13E-03	3.23E-03	5.13E-03	4.84E-05
Toluene	108883		7.30E-01		5.20E-01		5.20E-01	

* 0% moisture

2.3.3 Spatial and Temporal Allocation

Spatial allocation was not necessary since households were available by county. The survey included questions about seasonal burning habits. The fractions of activity occurring in each season are shown in Table 2-9 below.

Table 2-9: Seasonal Activity Fractions, Residential Wood Combustion

Area	Winter	Spring	Summer	Fall
Incorporated	0.44	0.20	0.03	0.34
Eastern WA w/forest	0.40	0.26	0.03	0.30
Eastern WA w/o forest	0.49	0.19	0.02	0.30
Western WA	0.39	0.25	0.07	0.29

2.3.4 Emissions Estimates

Annual and seasonal emissions for each wood burning device were calculated according to the following equations:

$$\text{tpy} = (\text{HH}) \times (\text{usage fraction}) \times (\text{seasoned tons burned/device-yr}) \times (0.8 \text{ T dry weight}/1 \text{ T seasoned weight}) \times (\text{pplt lbs}/\text{T dry weight}) \times (\text{T}/2000 \text{ lbs})$$

$$\text{tps} = (\text{tpy}) \times (\text{seasonal fraction})$$

3 Emissions Summaries

Annual emissions summaries are presented for criteria pollutants, ammonia, and diesel fine particulate matter (DPM2.5). Neither seasonal nor toxics (except DPM2.5) emissions are shown here, but they can be generated from the emissions inventory database. More detailed category breakouts can also be generated. Abbreviations used are shown below:

PT	point sources	LIVE	livestock wastes
PT_REG	small point sources treated as area sources	FERT	fertilizer application
SURFa	architectural surface coating	TILL_HARV	agricultural tilling and harvesting
GASSTN	gasoline stations	FIRE	wildfires, structure and vehicle fires
F_RES	residential fuel use: natural gas, oil, LPG	NAT	natural emissions from soil and vegetation
WSFP	woodstoves, fireplaces, inserts	ORM	onroad mobile sources
CONS	commercial and consumer solvents	ROADS	paved and unpaved road dust
OB_nonRES	agricultural, silvicultural, and rangeland burning	NRM_LAND	land-based nonroad mobile, except locomotives
OB_Res	residential outdoor burning: yard waste, trash	RR	locomotives
		SHIP	commercial marine vessels
		BOAT	recreational boats

Table 3-1: Annual Statewide Emissions in Tons

category	CO	NH3	NOx	PM10	PM2.5	DPM2.5	SO2	VOC
PT	51,785	498	42,341	8,376	5,141		23,226	16,675
PT_REG	602		1,045	1,002	632		140	1,568
SURFa								9,987
GASSTN								5,473
F_RES	1,738		4,255	369	362	58	1,187	239
WSFP	107,058		2,084	14,556	14,544		255	42,264
CONS								22,586
OB	43,473	13	1,403	4,315	3,698		4	3,429
OB_Res	11,130		587	5,156	4,737		75	1,673
LIVE		38,439						
FERT		15,676						
TILL_HARV				67,432	13,118			
FIRE	265,566	1,192	5,699	25,917	22,238		1,559	12,568
NAT	149,818	4,082	19,573					785,271
ORM	1,330,97	5,485	156,637	3,778	2,711	1,832	3,377	105,368
ROADS				63,695	4,891			
NRM_LAND	508,170	62	39,158	4,035	3,865	2,912	3,974	40,521
RR	2,719		21,032	512	471	471	1,546	955
SHIP	2,633		29,142	1,682	1,440	1,440	15,774	833
BOAT	62,911	8	2,373	399	368	28	155	22,838
Total	2,538,57	65,455	325,328	201,224	78,216	6,741	51,272	1,072,24

Table 3-2: Annual Statewide Emissions Source Percentages

category	CO	NH3	NOx	PM10	PM2.5	DPM2.5	SO2	VOC	VOC w/o NAT
PT	2%	1%	13%	4%	7%	0%	45%	2%	6%
PT_REG	0%	0%	0%	0%	1%	0%	0%	0%	1%
SURFa	0%	0%	0%	0%	0%	0%	0%	1%	3%
GASSTN	0%	0%	0%	0%	0%	0%	0%	1%	2%
F_RES	0%	0%	1%	0%	0%	1%	2%	0%	0%
WSFP	4%	0%	1%	7%	19%	0%	0%	4%	15%
CONS	0%	0%	0%	0%	0%	0%	0%	2%	8%
OB	2%	0%	0%	2%	5%	0%	0%	0%	1%
OB_Res	0%	0%	0%	3%	6%	0%	0%	0%	1%
LIVE	0%	59%	0%	0%	0%	0%	0%	0%	0%
FERT	0%	24%	0%	0%	0%	0%	0%	0%	0%
TILL HARV	0%	0%	0%	34%	17%	0%	0%	0%	0%
FIRE	10%	2%	2%	13%	28%	0%	3%	1%	4%
NAT	6%	6%	6%	0%	0%	0%	0%	73%	0%
ORM	52%	8%	48%	2%	3%	27%	7%	10%	37%
ROADS	0%	0%	0%	32%	6%	0%	0%	0%	0%
NRM LAND	20%	0%	12%	2%	5%	43%	8%	4%	14%
RR	0%	0%	6%	0%	1%	7%	3%	0%	0%
SHIP	0%	0%	9%	1%	2%	21%	31%	0%	0%
BOAT	2%	0%	1%	0%	0%	0%	0%	2%	8%

Table 3-3: County PM_{2.5} Emissions Estimates

County	PT	PT REG	F RES	WSFP	OB	OB Res	TILL HARV	FIRE	ORM	ROADS	NRM LND	RR	SHIP	BOAT	Total
Adams		47	1	18	11	9	1,595	0	27	230	76	42		1	2,057
Asotin		6	2	27	7	15	104	191	5	49	13		0	1	421
Benton	41		3	225	64	74	798	373	67	47	108	41	8	12	1,859
Chelan	115	4	1	148	81	41	1	3,488	31	35	47	15	0	6	4,013
Cllallam	157		1	213	63	76	4	585	22	8	41		378	6	1,554
Clark	328	53	12	988	26	340	44	8	133	26	180	24	37	20	2,219
Columbia			0	9	250	2	342	0	4	72	56	0	1	0	736
Cowlitz	305	34	1	239	38	80	11	2	58	7	52	17	68	8	922
Douglas	3	2	0	79	8	23	834	1	20	461	50		0	4	1,486
Ferry		0	0	21	63	6	16	139	6	92	23	0	0	0	366
Franklin		63	1	70	130	22	1,074	2	32	132	82	30	3	4	1,646
Garfield			0	4	107	1	295	0	3	93	21		2	0	527
Grant		119	0	91	125	42	1,234	92	47	473	134	13	0	6	2,377
Grays	617		2	176	72	58	8	1	33	25	41	0		5	1,039
Island	17		3	237	0	86	8	2	20	8	28		63	7	479
Jefferson	278		1	100	38	36	1	1	15	22	32		45	4	573
King	233		133	3,820	1	1,142	33	38	801	375	893	37	246	82	7,834
Kitsap	84		12	729	0	267	1	5	78	13	95	0	106	17	1,407
Klittitas		6	3	83	81	23	59	19	53	37	41	4	0	2	411
Klickitat	75		1	49	292	15	177	0	12	106	35	55	15	1	839
Lewis	1,307	92	2	208	63	74	30	1	50	23	45	12		4	1,911
Lincoln		0	1	14	13	6	1,721	0	16	286	98	25	0	2	2,182
Mason	130		1	178	25	67	2	1	21	15	25	0	3	7	475
Okanogan		40	0	94	426	28	82	15,343	22	176	31	0	0	2	16,244
Pacific	16		0	73	36	27	1	0	10	20	16		37	2	239
Pend		2	0	33	128	10	10	0	7	110	19	0	0	2	321
Pierce	177		38	1,884	104	643	25	16	294	38	428	21	89	39	3,797
San Juan			1	65		25	1	0	2	20	15		40	4	172
Skagit	271		8	272	15	92	119	2	59	20	70	5	63	13	1,010
Skamania	16	12	0	34	22	13	0	92	5	8	19	23	8	1	253
Snohomish	36		31	1,664	1	572	144	14	256	18	275	23	125	39	3,198
Spokane	162	125	51	880	114	234	748	253	175	748	191	51		24	3,757
Stevens	72	5	3	105	202	32	128	139	19	287	41	1	0	4	1,038
Thurston			14	647	23	229	13	5	106	24	103	9	4	14	1,190
Wahkiakum		0	0	14	33	5	2	0	2	7	1		58	1	124
Walla	209	9	4	106	348	28	912	1	21	77	80	13	3	2	1,813
Whatcom	372		14	461	4	156	100	4	67	32	96	6	33	13	1,358
Whitman	14	6	3	63	474	18	2,156	1	21	310	152	1	4	1	3,225
Yakima	106		12	421	208	117	284	1,418	88	363	113	4	0	9	3,141
Total	5,141	632	362	14,544	3,698	4,737	13,118	22,238	2,711	4,891	3,865	471	1,440	368	78,216

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PM2.5 Emissions in Tons per year from 2005 emissions inventory

County Name	fireplace		insert		pellet stove		woodstove	
	fireplace certified, catalytic	insert certified, non-catalytic	insert not certified	pellet stove certified, catalytic	woodstove certified, catalytic	woodstove certified, non-catalytic	woodstove not certified	
Adams	6	1	2	1	1	1	5	
Asotin	9	1	3	2	2	2	8	
Benton	76	8	29	9	9	17	62	
Chelan	26	3	17	6	7	17	63	
Clallam	24	6	37	4	9	20	101	
Clark	137	27	167	19	39	89	446	
Columbia	2	0	1	0	0	1	3	
Cowlitz	37	7	40	5	9	21	105	
Douglas	10	2	9	3	4	10	37	
Ferry	2	0	2	1	1	3	11	
Franklin	24	2	9	3	2	5	19	
Garfield	1	0	0	0	0	0	1	
Grant	31	3	11	6	3	7	25	
Grays Harbor	28	5	29	4	7	16	76	
Island	23	6	42	4	10	22	115	
Jefferson	10	3	18	2	4	9	49	
King	873	120	586	86	143	322	1,420	
Kitsap	70	19	129	13	30	68	358	
Kittitas	15	2	10	3	4	10	35	
Klickitat	6	1	5	2	3	6	24	
Lewis	23	6	36	4	8	19	99	
Lincoln	5	0	2	1	0	1	4	
Mason	13	4	32	3	7	17	90	
Okanogan	13	2	11	4	5	12	44	
Pacific	7	2	13	1	3	7	36	
Pend Oreille	3	1	4	1	2	4	16	
Pierce	273	53	317	37	75	169	840	
San Juan	5	2	12	1	3	6	33	
Skagit	42	8	45	5	11	24	119	
Skamania	3	1	6	1	1	3	17	
Snohomish	232	46	282	33	66	150	751	
Spokane	197	24	107	31	40	92	336	
Stevens	10	2	11	5	6	14	53	
Thurston	78	18	112	12	26	59	303	
Wahkiakum	1	0	3	0	1	1	7	
Walla Walla	23	3	13	4	5	11	41	
Whatcom	69	13	77	9	18	41	204	
Whitman	21	2	8	2	2	5	17	
Yakima	80	10	50	16	21	48	175	
State Total	2,509	411	2,288	347	586	1,329	6,147	

EPA's PM_{2.5} Standards: Old and New

	1997 Standards July 17, 1997		2006 Standards September 21, 2006	
	Annual	24-hour	Annual	24-hour
PM_{2.5} (Fine Particles)	15 µg/m³ Annual average	65 µg/m³ 98 th percentile	15 µg/m³ Annual average	35 µg/m³ 98 th percentile

Ecology's PM_{2.5} Goal

Ecology looked at many health studies, considered recommendations from EPA staff and EPA's Clean Air Scientific Advisory Committee, and examined Canada's PM_{2.5} standards. Based on this information, set a goal to keep PM_{2.5} 24-hour concentrations below 20 µg/m³.

Communities with more than 25 days over 20 ug/m3 in 2004 or 2005

Communities where the number of days that PM 2.5 exceeded 20 ug/m3 for 25 or more days	Potential nonattainment area	# of days where PM 2.5 exceeded 20 ug/m3 for 25 or more days				Approx population	Approx # of Households	Approx # of non-certified wood stoves/inserts/ pellet stoves and central furnaces**	Primary land use where monitor is located
		2004 Occurrences during the home heating season* Total	2005 Occurrences during the home heating season* Total	2006 Occurrences during the home heating season* Total	2006 Occurrences during the home heating season* Total				
Colville		34	62	39	4,988	1,270	137	Commercial	
Yakima	X	20	52	50	125,303	45,713	4,937	Residential	
Marysville		39	39	27	46,144	16,311	1,762	Residential	
South Tacoma	X	43	34	28	124,905	45,330	4,896	Residential	
South Seattle		38	34	20	866	382	41	Industrial	
Central Tacoma	X	39	34	27	38,971	14,527	1,569	Industrial	
Lacey		27	31	19	92,057	38,463	4,154	Residential	
South Park Community		42	31	26	34,643	13,744	1,484	Residential/Industrial	
Lynnwood/Mountlake Terrace		26	31	29	54,395	21,382	2,309	Residential/Industrial	
Kent		37	27	28	75,856	29,677	3,205	Commercial/residential	
North-Central Spokane		15	27	21	348,756	140,421	15,165	Residential	
East Spokane		20	26	26	15***	***	***	Industrial	
Lake Forest Park		33	24	23	12,452	4,769	515	Commercial/residential	
Totals (if applicable)					959,336	371,989	40,175		

*For the purposes of this project, the home heating season is thought to be October through April

**Approx # wood stoves = Approx # of households x rate of non-certified wood stove/insert/pellet stove and central furnace ownership per draft Washington State Base Year 2005 County Inventories

Statistics for communities with more than 25 days over 20 ug/m3 in 2004 or 2005

Communities where the number of days that PM 2.5 exceeded 20 ug/m3 for 25 or more days	Area used for numbers	% Minority	% Below Poverty	Years that a wood stove changeout program was conducted	Year that a wood stove changeout is scheduled (if applicable)
Colville	City (2006 OFM data)	7.8	14.7	2006	
Yakima	YRCAA Woodsmoke Control Zone	30.8	16	2005, 2006	2007
Marysville	Approx city limits and N. Marysville	12.9	5.1		
South Tacoma	PSCAA Tacoma PM 2.5 Air Monitoring. Study, slide 5 showing # of homes using wood heat as primary heat source, increased area beyond oval shown on map (slide 5)	38	16.6		
South Seattle	Small area between other air monitors	65.1	11.8		
Central Tacoma	Followed NE line used for S Tacoma then went across valley towards Milton back to the NW including the land jutting into the Sound located NW of the monitor	26	8.1		
Lacey	Approx city limits Lacey, Tumwater, Olympia, Tanglewild-Thompson Place	19.3	10.5		
South Park Community	NE half of point of land on which the	42.5	11.6		
Lynnwood/Mountlake Terrace	Approx city limits	26.7	8.4		
Kent	Approx city limits	31.9	11.5		
North-Central Spokane	SRCAA Smoke Control Zone	10.4	12.3		2007
East Spokane	SRCAA Smoke Control Zone	***	***		2007
Lake Forest Park	Approx city limits	17.8	4		

Other communities with 10 - 24 days over 20 ug/m3 in 2004 or 2005

Other communities where PM 2.5 exceeded 20 ug/m3 for 10 to 24 days in 2004 or 2005	Potential nonattainment area	# of days where PM 2.5 exceeded 20 ug/m3 for 10 or more days				2006 Occurrences during the home heating season*
		2004 Total	2004 Occurrences during the home heating season*	2005 Total	2005 Occurrences during the home heating season*	
Port Angeles				20	20	33
Darrington						21
Twisp		7	7	16	16	52
Ellensburg						17
Kennewick		10	10			22
Winthrop						52
Leavenworth				20	20	23
Puyallup	X	10	9	19	19	23
Vancouver	X	7	6	11	10	10
Bellevue		15	15	5	5	7
Wenatchee		18	18	14	14	
Shelton		15	14	10	10	
Olive and Boren Seattle		26	21	10	10	6
Longview		21	20	11	11	7
Redmond		13	12			
Seattle Beacon Hill Reservoir		13	11	8	8	4
Starbuck		10	10	3	3	5
Walla Walla		25	24	17	17	9

*For the purposes of this project, the home heating season is thought to be October through April

- scroll down half way to the wood stove changeout story [EXIT Disclaimer](#)

[Northern California Changeout Case Study](#)

[Oregon and Washington Great Wood Stove Changeout](#)

The [Pacific Northwest Tribal Air Network Workshop](#) (August 1-3, 2006) featured several presentations on programs and practices to reduce residential wood smoke.

A [feasibility study](#) [EXIT Disclaimer](#) undertaken for the Clean Air Foundation provides details on changeout program development.

For information about the 2001 Great Wood Stove and Fireplace Changeout campaign in the Great Lakes area (including parts of Canada), visit <http://www.woodstovechangeout.org/index.html> and <http://www.woodstovechangeout.org/materials/>

[Wood Stove Changeout Campaign](#) - EPA is working with partners across the country to encourage homeowners to replace older wood stoves with newer, cleaner burning stoves. Learn more about these changeout campaigns and how they can improve air quality. Also, check for updates on changeout pilot programs in your area.

Community Action - Laws and Ordinances

Certain jurisdictions have established legal requirements to reduce wood smoke. For example, some communities have restrictions on installing wood burning appliances in new construction. The most common and least restrictive action is to limit wood stove and fireplace use at those times when air quality is threatened. The appropriate agency issues an alert, similar to the widespread Ozone Action Day alerts.

[Model legislative language](#) [EXIT Disclaimer](#) has been developed by the Bay Area Air Quality Management District in California for communities wishing to take such action.

In 1998 the Bay Area Air Quality Management District, with stakeholder input, developed a model wood smoke ordinance for fireplaces and wood stoves as a guidance document for cities and counties that wish to regulate sources of particulate matter in their communities. The ordinance does not ban wood burning in fireplaces but seeks to take advantage of new, cleaner technologies that have been developed to effectively reduce wood smoke pollution.

This model ordinance template contains language pertaining to reduction of air pollution (PM10 is cited) by regulating the installation or replacement of wood burning appliances. This model ordinance covers all wood burning appliances:

- installed in new residences and commercial buildings
- being added to existing residences and commercial buildings
- that replace wood burning appliances in existing residences and commercial buildings.

[Certain Bay area cities](#) [EXIT Disclaimer](#) have already adopted model ordinances

[Bay Area Air Quality Management District](#) [EXIT Disclaimer](#)

Bans during "Spare the Air Tonight" advisories; requirements for new construction; replacement wood stoves must be EPA certified. Fireplaces must be certified by EPA to have emissions no greater than those of an EPA certified wood stove (wood heater).

Additional links to similar programs;

[Denver, CO](#) [EXIT Disclaimer](#)

Mandatory bans on "red" advisory days during the annual high air pollution season, with some exceptions.

Wasatch Front during winter inversions. RED: No residential/commercial burning. The Division of Air Quality staff inspect the valleys for smoke coming from chimneys. The staff also investigate complaints made to the Division. Offenders are ticketed, and fines may be levied. First-time offenders face a fine of \$25; second-time offenders pay \$50 to \$140; and third-time offenders face fines from \$150 to \$299. YELLOW: reduce burning; GREEN (clearing index high): burning allowed.

Prince Edward Island, Canada

Through their Residential Energy Assistance Program, the Canadian province of Prince Edward Island offers assistance to low-income Islanders EXIT Disclaimer in the form of a home energy efficiency upgrade, low interest loans (maximum \$5,000 in Canadian dollars per household at 6% interest rate), and a sales tax exemption on alternative heating systems such as wood stoves, pellet stoves, solar panels and geothermal units.

2007 Residential Wood Smoke Workshop - March 14-15, 2007, in Reno, NV

This third in a series of annual workshops brought together Federal, State, local, and Tribal air quality and health officials to share their experiences and knowledge about residential wood smoke and wood stove changeout programs. With each year, the base of knowledge and expertise in planning, managing, and evaluating wood stove changeouts expands, making these workshops an excellent opportunity to learn and network with others. For your reference, presentations used at the workshop are provided below.

You will need Adobe Acrobat Reader to view the Adobe PDF files on this page. See [EPA's PDF page](#) for more information about getting and using the free Acrobat Reader.

- [Bay Area Woodstove Changeout Program \(PDF\)](#) (24pp, 1.0 MB) J. Colbourn and R. Borrmann, Bay Area Air Quality Management District
- [Libby, Montana Woodstove Changeout Program \(PDF\)](#) (40pp, 2.5 MB) J. Marquez and R. Anderson, Lincoln County Health Department
- [Measurable Outcomes of a Woodstove Changeout on the Nez Perce Reservation \(PDF\)](#) (30pp, 3.3 MB) T. Moliga, Nez Perce Environmental Restoration and Waste Management
- [Oneida Woodstove Changeout Program \(PDF\)](#) (42pp, 6.2 MB) J. Mears, Oneida Environmental Health and Safety Division
- [PM2.5 Monitoring Data for Libby, MT \(PDF\)](#) (15pp, 57k) J. Coefield, Montana Department of Environmental Quality
- [Sacramento Wood Stove/Fireplace Change Out Program \(PDF\)](#) (29pp, 980k) A. Kennard, Sacramento Metropolitan Air Quality Management District
- [Social Marketing and Woodstove Exchange \(PDF\)](#) (41pp, 3.5 MB) T. Wakelin, British Columbia Ministry of Environment
- [USDA Rural Development Overview \(PDF\)](#) (20pp, 148k) M. Ramme, U.S. Department of Agriculture
- [Warm Homes, Clean Air: An Oakridge Community Project \(PDF\)](#) (20pp, 1.1 MB) Sally Markos, Lane Regional Air Pollution Authority
- [Washoe County Woodstove Changeout Program \(PDF\)](#) (6pp, 89k) A. Goodrich, Washoe County District Health Department