ANNEX 3: BENEFITS OF CERTIFIED STOVES

Emissions Comparison

Table 5 presents the emission factors for the criteria air contaminants for different categories of wood burning appliances.

Table 5: Criteria Air Contaminant Emission Factors for Residential Wood Combustion (kg/tonne of dry fuel)[1]

Appliance	TPM	PM10	PM2.5	SOx	NOx	VOC	CO	Notes
Conventional Fireplaces								
• Without glass doors	19.3	18.5	18.4	0.2	1.4	6.5	77.7	1
• With glass doors	13.5	13.0	12.9	0.2	1.4	21.0	98.6	1
Fireplaces with Inserts								
• Conventional	14.4	13.6	13.6	0.2	1.4	21.3	115.4	2
• Advanced Technology	5.1	4.8	4.8	0.2	1.4	7.0	70.4	2
Advanced Tech. Fireplaces	5.1	4.8	4.8	0.2	1.4	7.0	70.4	3
Conventional wood burning stoves								
• Not air-tight	24.6	23.2	23.2	0.2	1.4	35.5	100	4
• Air-tight	14.4	13.6	13.6	0.2	1.4	21.3	115.4	4
Advanced technology wood burning stoves	5.1	4.8	4.8	0.2	1.4	7.0	70.4	4
Central furnaces/boilers	14.1	13.3	13.3	0.2	1.4	21.3	68.5	5
Pellet stoves	1.2	1.1	1.1	0.2	1.4	1.5	8.8	6
Other equipment	14.4	13.6	13.6	0.2	1.4	21.3	115.4	4,5

Notes.

1. Assistance in the identification and review of documents and recommendations for the development of emission factors was provided by Dr. James E. Houck, Vice President of Research, OMNI Environmental Services Inc., Beaverton, Oregon.
2. The emission factors for conventional fireplaces with and without doors were developed from an analysis of a large number of studies, since no single definitive study exists. There is no widely recognized test protocol for conventional fireplaces, so different fuels, load configurations and test procedures are used in various studies. As a result, each of the studies analyzed provides only emission results under specific conditions, and may only provide context for findings from other studies.
3. Emission factors for fireplace inserts are the same as for the corresponding free standing wood stoves. See note 5 below for discussion of data used in the development of these emission factors.
4. Advanced technology fireplaces may be treated the same as advanced wood stoves since they meet the same emission standard and their emission control technologies are similar. See note 5 below.
5. Emission factors for conventional and advanced wood stoves, fireplace inserts and advanced fireplaces were developed from an analysis of a large number of studies. Although different emission factors are sometimes reported in the literature, the emissions for catalytic and non-catalytic advanced wood stoves are combined in a single average factor to reflect the long-term performance profiles of these two emission reduction technologies. Correcting to account for differences in test methods and adjusting for higher burn rates recorded during field testing, the particulate matter emission factor for new catalytic stoves would be 3.2 g/kg of fuel burned and for non-catalytic stoves the factor is 5.1

g/kg. Therefore, to avoid the potential for distortion of total emissions for the entire population of advanced stoves, and to account for the fact that the majority of advanced stoves used in Canada are of the non-catalytic type, the single emission factor for non-catalytic stoves is used.

6. The emission factors for central furnaces and boilers were based on the analysis of the few available studies. One of the referenced studies reported on testing of two outdoor boilers. Therefore, the emissions performance of these systems is reflected in the average emission factors for central furnaces and boilers.
7. The emission factors for pellet stoves were developed from the analysis of several studies.. However, because of the relatively small number of pellet stoves in use in Canada and because the surveys used did not specifically ask respondents if their appliances burned pellets, it was not possible to develop a useful estimate of the number of pellet stoves in use. The emission factors are provided here for information only and may be useful in the future if a better estimate of the number of pellet stoves in use is developed.

A joint study, conducted by Environment Canada and the HPAC in December 2000, compared the releases from a conventional wood stove and a US EPA certified (non-catalytic, advanced technology) wood stove for a number of pollutants[5]. The study found that releases of PM, VOCs and PAHs from the certified stove were significantly less than those from the conventional stove. The emissions of dioxins and furans were not conclusive--more research is required to better determine how dioxins and furans are formed in residential wood-burning equipment. On average, releases of substances from the certified stove compared to those from the conventional stove are:

- 94% less for PM;
- 80% less for VOCs; and
- 85% less for PAHs.

Energy Efficiency

Certified wood stoves are also more energy efficient than conventional wood stoves. Table 6 presents the different levels of efficiency measured according to studies by the US EPA.

Table 6: Net efficiency of various wood heating appliances

Type of wood stove	Net efficiency (%) US EPA[7]
Wood stoves	
conventional	54
non-catalytic	68
Pellet stoves	
certified	57.6 to 75.2
non-certified	33.4 to 70.5
Masonry heaters	54 to 65

Note: Net efficiency rests on combustion efficiency and heat transfer efficiency.

Price Comparison

Prices vary by retailer, but generally, costs for a certified stove range from $500 to $700 more than a conventional wood stove.

Low Emission, New Technology Alternatives to Conventional Uncertified Stoves Burning Cordwood

Stove/Product	% Emissions Reduction Potential	Total Initial Cost*	Annual Costs Compared to Conventional Stoves Using Cordwood
Certified Non-Catalytic Stoves	71%	$2075	$67 less
Certified Catalytic Stoves	74%	$2425	$16 less
Pellet Stoves	92%	$2385	$145 more
Masonry Heaters	85%	$10,500	$109 less
Manufactures Densified Fuel	27%	$0	$ 291 more

* Includes unit, installation and chimney work costs

Lower Emission Alternatives Compared to Existing Zero-Clearance and Masonry Open Radiant Fireplaces Used as Supplemental or Primary Heat Sources

Stove/Product	% Emissions Reduction Potential	Total Initial Cost*	Annual Costs Compared to Conventional Stoves Using Cordwood
Certified Non-Catalytic Stoves	94%-98%	$1850	$11 less
Certified Catalytic Stoves	94%-98%	$2200	$52 more
Pellet Stoves	94%-98%	$2400	$53 more
Masonry Heaters	100%	$2300	$139 less
Manufactures Densified Fuel	100%	$2300	$102 less

* Includes unit, installation and chimney work costs