

# PELLET STOVES REVISITED:

## New Generation of Pellet Stoves Offer Environmental Advantages

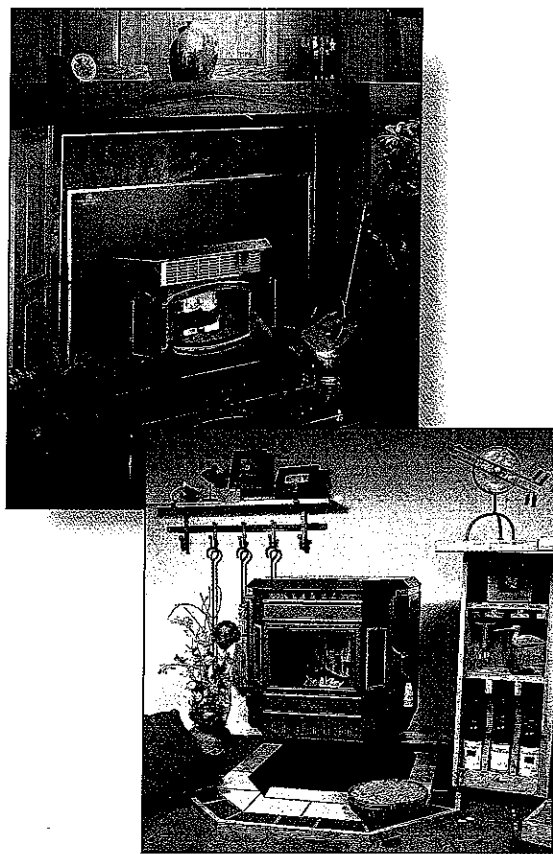
In terms of environmental impacts, pellet stoves are arguably one of the best home space heating options available. They also offer the political and economic advantages of utilizing a renewable non-fossil fuel.

The utilization of wood for home heating suffers an environmental stigma based on the environmental performance of old wood burning appliances. As most of us familiar with wood burning know, wood burning appliances have improved dramatically in their environmental performance and the HPA has sponsored a considerable effort to get the word out about new appliances. In recent years OMNI Environmental Services has conducted several studies on new technology wood burning appliances for the HPA and has presented and published the results in public forums.

Even though pellet stoves have really only been around for about ten years, the new generation of stoves is cleaner and more reliable than the earlier models, which were themselves quite clean as compared to uncertified cordwood stoves. To document this better performance, the HPA in association with the Pellet Fuels Institute (PFI) contracted OMNI to measure emissions from new state-of-the-art pellet stoves. The results were clear — they have significantly lower air emissions than the earlier models.

According to HPA statistics, sales of pellet stoves have stalled. In contrast, other "green" products are having success in the marketplace and the advertisement of products as "green" seems to be a sign of our times. The results of the HPA/PFI-sponsored research on new pellet stoves, when combined with the results from other recent HPA-sponsored work on the general environmental attributes of wood burning, provides more than adequate documentation of the environmental soundness of pellet stoves. Pellet stoves can be rightfully advertised as a green product.

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### Low greenhouse gas impacts

Heating with wood has the lowest greenhouse gas impact of all the major space heating options (i.e., natural gas, fuel oil, kerosene, liquefied petroleum gas, electricity, wood and coal). A complete analysis recently presented at an international conference cosponsored by the Air and Waste Management Association and the United States Environmental Protection Agency showed that when all the steps involved in energy production are taken into consideration, home heating with wood produces less than one half the amount of carbon equivalents of greenhouse gases per unit of energy than any other home heating option. The release of methane and carbon monoxide

into the atmosphere from the chain of events leading to the production of space heat are responsible for the greenhouse impacts from home heating. In addition to the high energy return on investment (EROI) associated with pellets, the fact that harvesting of mature trees for fuel permits more rapid carbon fixation in younger replacement trees reduces the effective greenhouse impact from pellet burning.

### Low acid precipitation impacts

Most acid precipitation impacts are produced by sulfur gases or nitrous oxide gases released during the extraction, processing and the high temperature combustion of fossil fuels. Little fossil fuel is invested in the produc-

tion of space heat from pellets. A detailed analysis of emissions from each step of the energy trajectory conducted for the same study as for the greenhouse gas impact showed that residential wood combustion had the lowest acid equivalents (a measure of the acid precipitation potential) per unit of heat among the home space heating options.

### Low ozone impacts

Ground-level ozone (the primary constituent of smog) is a summertime pollution problem, and as such is usually not an air pollution problem related to space heating.

### Low particulate impacts

Residential wood combustion has been identified as a major source

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of particles on a national basis. Small particles with aerodynamic diameters of less than 10 microns are referred to as PM10. PM10 is a federal criteria pollutant for which there are national ambient air quality standards. Virtually all the particles emitted by residential wood combustion are in the PM10 category.

Research conducted by OMNI in Medford and Klamath Falls, Oregon during the 1989/1990 and 1990/1991 heating seasons with both exempt and certified pellet stoves has been the basis for particulate emission factors published by the EPA (in a document called AP-42). These emission factors are used nationally by regulators and planners as the "credible" values for emissions from pellet stoves. The emission factors based on the two OMNI studies and published in AP-42 showed that emissions of particles from pellet stoves are low and much lower than emissions from cordwood stoves. The average emission factors for the certified pellet stoves, exempt pellet stoves and uncertified cordwood stoves shown in the document are 2.1 g/kg, 4.4 g/kg and 15.3 g/kg, respectively. Quite clearly pellet stoves offer a significant environmental advantage over uncertified cordwood stoves in regards to particulate emissions.

It has been the perception that the new generation of pellet stoves has even lower particulate emissions than those models first introduced in the late eighties and early nineties. Key improvements in the newer models include electronic and microprocessor control of com-

bustion air, fuel feed and convection fans. The HPA in association with PFI contracted OMNI to evaluate air emissions from state-of-the-art pellet stove models. The study included testing of two pellet stove types (top feed and bottom feed), two pellet fuel types (softwood and hardwood) and three burn rates (low, medium and high). The results of the study were unequivocal — the emissions of particles from the new generation of pellet stoves were even lower than from the older models.

### Low carbon monoxide impacts

Carbon monoxide, like PM10, is a federal criteria pollutant for which there are national ambient air quality standards and for which emissions from wood combustion are considered significant. Like particles, the two studies conducted by OMNI on certified and exempt stoves in Medford and Klamath Falls, Oregon during the 1989/1990 and 1990/1991 heating seasons are the basis for emission factors for pellet stoves listed by the EPA in the AP-42 document. Also like particles, the emissions of carbon monoxide are much lower from pellet stoves than from conventional cordwood stoves. The emission factors listed in AP-42 for certified stoves, for exempt stoves and for conventional cordwood stoves are 19.7 g/kg, 26.1 g/kg and 115.4 g/kg, respectively. (The AP-42 document apparently erroneously lists the emission factor for certified pellet stoves as 19.7 g/kg rather the 22.4 g/kg value reported in the referenced OMNI study.) Carbon monox-

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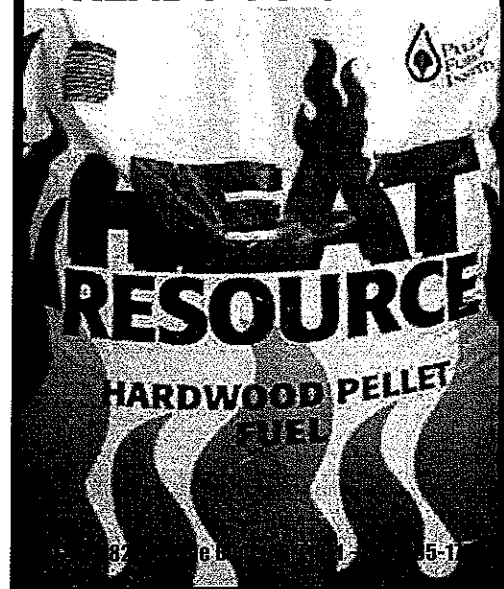


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ide was measured along with particles for the state-of-the-art pellet stoves evaluated in the HPA/PFI study. Again, like particles, the emissions of carbon monoxide from the new pellet stoves were dramatically lower than from the older models.

#### Low solid wastes

The residue (unburned char and inorganic salts) remaining after combustion of fuel in a cordwood stove typically ranges from one to five percent of the fuel mass. The residue in a pellet stove averages less than one

half percent of the fuel mass. The efficiencies of pellet stoves are considerably higher than of cordwood stoves. For example, the default efficiency for a pellet stove used in the EPA certification process is 78% whereas the efficiency for an uncertified stove listed in AP-42 is 54%. Consequently, less fuel mass is required to satisfy the same heat demand with a pellet stove than with a cordwood stove. Less fuel mass burned and a lower percent residue production combined make solid waste disposal from pellet stoves significantly less of an issue than for cordwood stoves. In addition, wood ash (derived from cordwood or pellets) is relatively benign. In fact, its high calcium carbonate and potassium contents make it a good soil amendment.

#### Low dependence on fossil fuels

It has been estimated that residential wood combustion only accounts for 9% of the energy used to meet the nations space heating needs. The economic, political and environmental motivations to expand the use of renewable energy resources and lessen our dependency on fossil fuels is known to all of us. Besides the obvious fact that pellets are a renewable biomass fuel, the EROI for pellet fuels has been demonstrated to be high (i.e., the fossil fuel investment to produce and distribute pellets is low).

#### Low sales

As reported in the July-September 1999 HPA Journal, the shipment of pellet stoves in 1998 was 15% lower than in 1991 and among the



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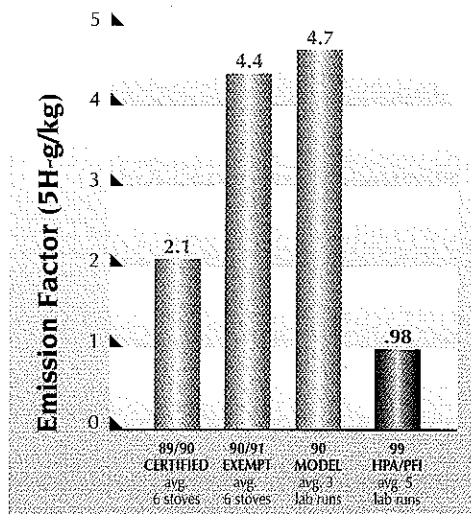
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hearth industry appliances, pellet stoves only represented 3% of the total units shipped.

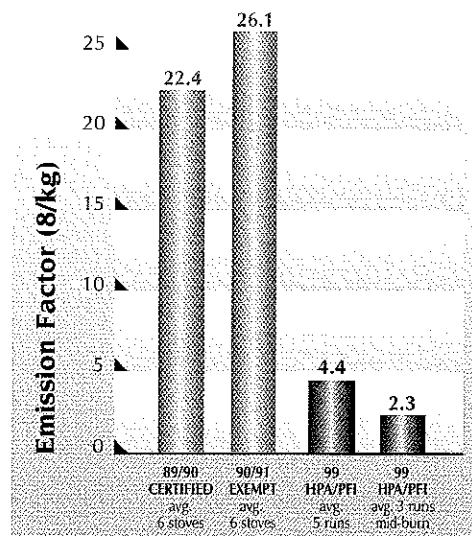
### High potential

Data is currently available to document and promote the environmental soundness of home heating with pellets. Based on our understanding of pellet fuel and state-of-the-art stoves, it is anticipated that even further environmental advantages of home heating with pellet stoves could be documented. For example, pellet stoves are speculated to have low emissions of air toxics which is an upcoming air quality issue.

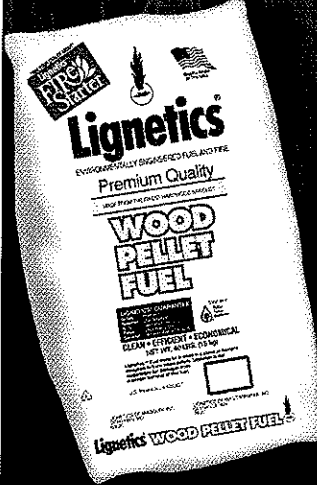
**Fig. 1** Comparison of Particulate Emissions Between Old and New Model Pellet Stoves



**Fig. 2** Comparison of Carbon Monoxide Emissions Between New and Old Model Pellet Stoves



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