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National Policy Impacts Derived from  
The Crested Butte Wood Stove Study

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## Introduction

Levels of small particles or PM10 exceed the National Ambient Air Quality Standards (NAAQS) in over 70 cities and small communities across the United States. In approximately one-half of these impacted towns and cities, emissions from wood stoves comprise a significant portion of the particulate pollution problem. The results of a unique wood stove study conducted in Crested Butte, Colorado will have significant impacts on the policies and programs designed to reduce PM10 levels and meet the NAAQS.

In the Crested Butte Wood Stove Study, measurements were taken for: ambient PM10 levels, visibility, and emissions from conventional stoves all during the winter of 1988/1989. During the fall of 1989, 281 existing conventional wood stoves were either retired or replaced. In total, 191 stoves certified by the Environmental Protection Agency (EPA) as meeting Phase II emission standards were installed replacing the older stoves. Then in the winter of 1989/1990 the same set of measurements were made again. In general, ambient levels of PM10 were found to decrease by 40%, visibility improved by 59% and individual stove emissions decreased by 67% when comparing older, conventional stoves to the newer, EPA certified stoves.

The Environmental Protection Agency (EPA) agreed to lend financial and technical support to the Crested Butte Study with the intentions of accomplishing the following objectives:

1. Characterize the emissions of existing and new technology stoves (EPA NSPS stoves) in home use at high altitudes.
2. Determine the air pollution benefits for an entire community by converting all existing, conventional stoves to stoves capable of meeting EPA standards.
3. Develop and validate a "short" emissions test that is capable of measuring particulate emissions from stoves in home use. The cost of the short test should be significantly lower than current test procedures.

In general, all of the objectives established for the Crested Butte Study were met.

More detailed descriptions of the conduct of the study and more complete description of the results can be found in papers presented at the 84th Annual Meeting of the Air and Waste Management Association by William Crank, Dennis Jasma, John Crouch and Steve Arnold.

Also, in a technical report by Dennis Holzschuh, of EPA's Emission Measurement Branch<sup>1</sup> results are reported on an evaluation of the in-home emission sampler developed by Virginia Polytechnic Institute versus the EPA Method SG test used for the certification of wood heaters.

## **Description of Policies that May Be Impacted**

### EPA's New Source Performance Standard (NSPS) for Wood Stoves.

In 1988, EPA established a NSPS for wood stoves through regulatory negotiation (Federal Register, February 26, 1988). The NSPS required all new wood heaters to be certified by EPA as meeting certain emission limits. The emission limits were selected for two phases. The more stringent standards for PM10 which applied to the new stoves used in the Crested Butte Study were 4.1 grams per hour for catalyst equipped stoves and 7.5 grams per hour for non catalytic stoves.

### Credits for Wood Stove Emission Reduction Strategies Contained in State Implementation Plans (SIP).

When a SIP is necessary to reduce emissions sufficiently to meet NAAQS, the state or local agency will rely on EPA guidance to determine the credits that can be taken for various strategies. In the case of wood smoke reduction strategies, the relevant guidance is contained in EPA450/2-89-015, "Guidance Document for Residential Wood Combustion Emission Control Measures". This guidance document addresses public information and awareness, improving wood burning performance, reducing the use of wood stoves in a community, and curtailment of wood burning during potential high pollution days. Based on this guidance, EPA conducts a review of the SIPs submitted to insure reasonable credit is and be attributed to each specified strategy.

### Reasonably Available and Best Available Control Measures.

Section 190 of the Clean Air Amendments of 1990 require EPA to issue guidance on reasonably available (RACM) and best available control measures (BACM) for residential wood combustion. The guidance for RACM has to be issued within eighteen months and the guidance for BACM within three years of the date of enactment of the new law. The PM10 SIPs must contain provisions to assure that reasonably available control measures shall be implemented no later than December 10, 1993. If an area seeks an extension beyond 1993, it will be classified as "serious" and must implement BACM within four years after reclassification.

### **Lessons Learned From Automobile Pollution Control Programs**

In some ways efforts to control pollution from wood stoves are similar to the struggle to control pollution from automobiles. For example, EPA established standards for automobiles and devised a laboratory test to insure the new cars could meet those standards. And cars did meet the standards in the lab. But now we know that once a car gets into the hands of a consumer, emission control systems can be altered, in-use conditions can drastically affect performance, and deterioration control systems and the car itself can change going-in assumptions. With in-use testing programs, EPA found that the pollution emissions from cars on the road can drastically differ from the emissions measured in the laboratory.

In the earlier automobiles, consumers adjusted the carburetor to make the cars purr. The problem was often carbon monoxide emissions shot sky-high. EPA had to devise ways to limit the range for the carburetor adjustment screw. Bowing to rumor and misinformation, many people, including some local police forces, thought cars would have more power if you sawed off the catalyist. EPA had to develop information and enforcement programs to stop that practice.

Automobiles deteriorate. Their spark plugs get fouled, things go out of adjustment, and as a result they produce much more pollution than they do in the laboratory. EPA and the states had to devise inspection and maintenance programs coupled with public information programs to correct problems of deterioration.

Wood stoves are also owned by consumers. The personnel involved in the Crested Butte Study anticipated some of the problems associated with installation and day-to-day operation of wood stoves and implemented some measures to prevent the kind of problems that occurred with automobile owners. Some of these prevention practices may find their way into policy changes that will be described in the next section.

### **Potential Policy Impacts From the Crested Butte Study**

#### Possible Changes to EPA's New Source Performance Standard for Wood Heating Devices.

In a situation similar to automobiles of the late 1970s and early 1980s, the pollution emission characteristics of wood stoves are quite different in the field than they are in the laboratory and are highly dependent on the knowledge, willingness and capability of the consumer. In the Crested Butte Study it was found that on the average, catalyst equipped stoves emitted 10.5 grams of particulates PM10 per hour and non catalytic stoves emitted 10.4 grams per hour. For catalyst equipped stoves, the emission levels in the field are more than twice the standards achieved in the laboratory.

This result was expected. The laboratory test has to be standardized to insure that it can be repeated and to insure the test does not create a bias in the results from stove test to stove test. As a result, the test does not represent field conditions for the quality of the fuel and the variations experienced in the burn rate of stoves in homes.

The results of the field tests in Crested Butte are still being processed. Consequently, definitive guidance that relies on the study will have to wait. However, there are some indicators from the study that allow speculation on potential policy changes. For example, the study found that there were significant differences in the emissions from the same make and model stove by the same manufacturer that had been installed in different households. This would seem to point to differences in the way that people operate their stoves. This suspicion was partially supported by an anecdote. It was noticed that for one household, the emissions had been very low during the first two weeks of testing. During the third week of testing, the emissions skyrocketed. Upon further investigation, it was found that the member of the household who usually operated the stove was in bed with the flu and his duties were taken over by some one else who was not familiar with best practices for using a wood stove.

Other observations during the study of how people who are not well trained cause high emissions with poor practices may point to the need for more "tamper proof" systems. Just as EPA built in limitations for the carburetor adjustment screw, revisions to the NSPS could be made to limit the amount of reliance on the wood stove operator. One area that needs to be examined is the operator's involvement with the catalyst by-pass. For example, one could start with devising better and more accurate ways to convey temperature information to the operator. A further step in this process would be to devise a mechanical or electrical method to close the catalyst by-pass when the ideal temperatures are reached.

During the two years of study in Crested Butte, an extensive data base has been collected. This data base can serve as the ideal foundation for examining a crucial question concerning wood stoves, that is how well will they hold up over time? Will, just as our experience has shown for automobiles, emissions increase as the stoves get older? What will the deterioration rates look like and if deterioration is excessive, how can it be mitigated?

Credits for Wood Stove Reduction Strategies Contained in SIPs. New stove installation in Crested Butte was supervised by trained personnel. Information pamphlets were provided with the new stoves. In addition, after new stove installation, chimney watch drive-by inspections were made by trained personnel who, when spotting an unusually dense plume from a chimney, would work with the stove owner to take corrective action. EPA's current guidelines contain material on how to add a

1. D. Holzschuh, Woodstove Test Method and Fuel Comparison Study, EPA Method SG vs VPI, Modified EPA Method 28 vs Cordwood, RTP, North Carolina and Crested Butte, Colorado,

EPA Contract No. 68D90055.

2. J. Calcagni "PM10 Moderate Area SIP Guidance: Final Staff Work Product" Environmental Protection Agency, April 2, 1991

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