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**Upgrading Woodstoves in a Small Town
as a Primary Strategy
Towards Visibility Improvement**

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INTRODUCTION

Residential woodsmoke is often found to be a contributor to PM-10 violations in small communities in the Western United States. Residential woodsmoke is a classic area source, and remediation of this source has proved to be much more difficult than was originally thought.

As the air pollution control community begins to develop the new approaches that will be needed in the coming decade to deal with area sources of this type, it has become clear that strategies which rely strictly on control technology (RACT and BACT) will fail to stimulate the desired improvements in air quality. It is commonly recognized that proper remediation of these area sources will involve control measures as much, or more, than they will involve control technology. The latest amendments to the Clean Air Act recognize this with the creation of the new concepts of Reasonably Available Control Measures (RACM) and Best Available Control Measures (BACM).

This paper discusses a unique co-operative program, involving both the public and private sector, to test one of the obvious candidate strategies for woodstove BACM. The author was the representative from the Wood Heating Alliance to this experiment, and this paper will examine the test from the private-sector perspective. The Wood Heating Alliance is the national trade association of manufacturers and distributors of woodstoves, fireplaces, gas logs, and chimneys.

During the winters of 1988-89 and 1989-90, a major study of the effects of a woodstove replacement strategy was conducted in Crested Butte, Colorado. Sponsors of the study included Region Eight of the USEPA, the Colorado Department of Health (CDH), the Wood Heating Alliance (WHA), and the town of Crested Butte. The study measured the effect of a woodstove replacement ordinance by measuring the ambient particulate concentrations both before and after the conventional woodstoves were replaced with certified appliances.

HISTORY OF THE PROJECT

The Colorado Department of Health and the woodstove industry have long been interested in verifying the impact of a PM-10 strategy that focuses on appliance rollover, i.e., on replacing conventional woodstoves with certified woodstoves. In the spring of 1988, John Leary, Deputy Director of the Air Pollution Control Division of the CDH, approached the woodstove Industry regarding our participation in a test of woodstove replacement as a PM-10 control strategy in the town of Crested Butte. While Crested Butte was a Group II rather than Group I PM-10 area, the town council had determined that visibility was an important economic resource, and that impaired visibility, especially during the winter, could have disastrous consequences for their reputation as a vacation destination. Baseline data collection during year 1 and a Chemical Mass Balance study performed by CDH indicated that woodsmoke contributed 60-80% of the PM-10 inventory on high pollution days.

The CDH's proposal was that the industry facilitate an effort by the town to change the majority of its woodstoves from conventional to Colorado Certified stoves during a single year. The CDH planned to document the impact of this strategy by extensive monitoring of the town's ambient air before and after the change was made.

THE TOWN AND IT'S ORDINANCE

Crested Butte is a high mountain town which was founded by coal miners in the 19th century. Now its principle economic activity is to provide support for a ski area located two miles away. Although it is often referred to as a "ski town," the large numbers of condominiums with fireplaces, which often characterize ski towns, and are often a facet of their emissions inventory, are located at the ski area. This area is not only physically separated, it is also separated by a major down-valley drainage which tends to isolate it's woodsmoke from that of Crested Butte.

Residents of Crested Butte tend to fall into two major groups: (1) a small number of retired coal miners, and (2) a large number of people who were initially attracted by the ski area and have settled in the community to raise their families. There is a seasonal influx of young adults who come to work at the ski resort. They tend to occupy older rental homes. While some of the housing stock in the town may only contain 900 sq feet, it is often old enough that it contributes to a relatively high wood consumption per household. Previous to the changeout, the average wood usage of year-round households in the town is estimated to be four cords (512 cubic feet) of ponderosa pine and oak a year.

From the town's point of view, the compelling advantage to industry's participation in such a study was the need to facilitate the woodstove changeouts required by an existing town ordinance. In 1986, the town had passed a woodstove ordinance with several important provisions:

- 1) Upgrade of existing woodstoves to certified units whenever a home was sold.
- 2) Stiffer insulation standards for new homes.
- 3) A requirement that all woodstoves in the town be upgraded within three years (September 1989) or every household that had not upgraded would be required to pay a \$30/month polluters fee. The fee option would expire after three years, at which time it would be illegal to use any uncertified appliance.
- 4) An exemption from this ordinance for residents who had burned coal since the 1930's. (This provision reflected the town's heritage as an old coal mining town, and a concern that the handfull of older miners not be forced into this program.)

As the date certain, September 1, 1989, approached, the town had become increasingly concerned that the majority of households would wait to the last minute before taking action and, might choose to test the town government's willingness to enforce the polluters fee. Thus, the town's leadership was intrigued by any package which might facilitate the changeouts.

Some members of the woodstove industry had severe reservations about using Crested Butte as the location for an ambient study. The town has an elevation of 8900 feet above sea level, which was believed to impact the emission performance of certified stoves. The town also experiences an average of 11,500 heating degree days, which clearly classifies it as an atypical climate. Not withstanding these concerns, however, the industry was interested in a "whole town test" of the new certified stoves, and agreed to be involved in and support the study in several areas.

ADDITIONAL STUDIES

Two additional studies were also conducted in Crested Butte during the two years of this ambient study. Jack Hidinger of Region Eight and Bob McCrillis of EPA-OAQPS were able to secure funding for an in-situ study of stoves in Crested Butte. The study was conducted by Dr. Dennis Jaasma of Virginia Polytechnic Institute, Blacksburg, Virginia. The study utilized a new woodstove field sampling device, the VPI sampler. Twelve stoves were sampled during the first, or "baseline," winter period. Ten of the stoves were conventional stoves, and two of the stoves were existing certified stoves (Colorado Phase II/EPA Phase I). During the second year, a total of 27

appliances were monitored: 7 conventional woodstoves, 12 catalytic stoves, 5 non-catalytic stoves, and 3 coalburning appliances.

The second study was commissioned by USEPA Emissions Measurement Branch to determine the relationship of results between the VPI sampling method and EPA Methods 5G/28. In addition, this study, conducted by Engineering Science Inc., examined the effects of elevation on both particulate and Carbon Monoxide emissions, the emissions of regular cordwood versus Method 28 test fuel, and the emission of a low tech (Ashley Oval) stove. This study concluded that there is insufficient justification for an altitude differential in woodstove certification programs.

AMBIENT MONITORING

The Colorado Department of Health initiated an expanded ambient air and meteorological monitoring program for Crested Butte during the winter of 1988-89. As is the case with many small communities with PM-10 problems, Crested Butte does not have access to sufficient meteorological data necessary for any of the accepted computer models. Thus, in addition to the air monitoring, CDH installed a met station in the town. Temperature, wind direction, and wind speed were obtained on an hourly basis for all the winter months.

A continuous nephelometer with a strip chart recorder was operated during the winter, as was a PM-10 sampler, which used both quartz and teflon filters. Chemical speciation was performed by Desert Research Institute.

CHRONOLOGY OF YEAR TWO

The second year of the study was the critical portion of the process from the standpoint of the town's residents. During 1989, their final deadline occurred, after which they would be charged \$30/month on their town water bill until they either removed or upgraded their stove.

In February and March of that year, the town and the WHA sponsored a house to house survey to determine: 1) the number of conventional and certified woodstoves in the town, as well as the number of open fireplaces; 2) types of woodstoves, and how well they were installed; 3) the amount of wood used by each household; and 4) the names and phone numbers of both the owners and occupants of each dwelling. The survey was complicated by the high number of out of town owners in Crested Butte, and by the fact that many households do not often use their true legal address (mail is delivered via post office boxes).

In June, the Wood Heating Alliance sponsored a "WOODSTOVE FAIR" to expose the local residents to the stoves which the industry was offering at a reduced price. Five manufacturers had agreed to offer ten models at wholesale cost or less to facilitate the changeout program. The units were all certified by the CDH woodstove program, which meant in practice that the majority of them (eight) were catalytic stoves. This was due to a Carbon Monoxide standard coupled with an altitude adjustment factor that have both since been dropped from Colorado's program. One of the non-cat woodstoves models was already certified to EPA Phase II, but the other was only certified to Phase I.

The local residents were offered woodstoves at two prices, the major discount required that the stove be purchased by August 15th. A slightly better price was offered if the unit was purchased by June 20th. As anticipated, the early bird discount did encourage people to make up their minds and get started early. The terms were cash in full for the stove. These funds were escrowed by the local bank until the stove was received by the local resident, at which time the bank disbursed the funds to the manufacturer. All delivery and installation was kept separate and was handled by the local chimney sweep. The local sweep, Bill Smith, also handled all the paperwork and arrangements necessary in this type of transaction and received a 10% commission for this and for the normal customer followup. 165 households took part in the special stove program, and the majority of these