Preliminary Report

Clearing the Smoke

THE WOOD STOVE CHANGEOUT IN LIBBY, MONTANA

wood stove CHANGEOUT

HPBA Hearth, Patio & Barbecue Association

The Hearth, Patio & Barbecue Association thanks the following key partners for their contributions to the Libby wood stove changeout program:

U.S. Environmental Protection Agency

Montana Department of Environmental Quality

Lincoln County

University of Montana, Center for Environmental Health Sciences

National Fireplace Institute®

About HPBA

The Hearth, Patio & Barbecue Association (HPBA) is an international trade association first established in 1980 to represent and promote the interests of the hearth products industry in North America. In 2002, the Hearth Products Association (HPA) merged with the Barbecue Industry Association (BIA) to form HPBA. The association includes manufacturers, retailers, distributors, manufacturers' representatives, service and installation firms, and other companies and individuals - all having business interests in and related to the hearth, patio, and barbecue products industries.

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Clearing the Smoke:
The Wood Stove Changeout in Libby, Montana

Table of Contents

I.	Executive Summary	2
II.	Introduction to Libby, Montana	4
III.	What Is a Wood Stove Changeout?	8
IV.	The Libby Program	10
	Phase I	11
	Phase II	14
V.	Results	18
VI.	Lessons Learned	20
VII.	Is a Changeout Program Right for Your Community?	22
VIII.	Acknowledgements	24

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Executive Summary

The story of Libby, Montana, is one that reveals an idyllic location masked by economic concerns, devastating health problems and a location that trapped dangerous emissions atop a population that could not have been worse-equipped to deal with them.

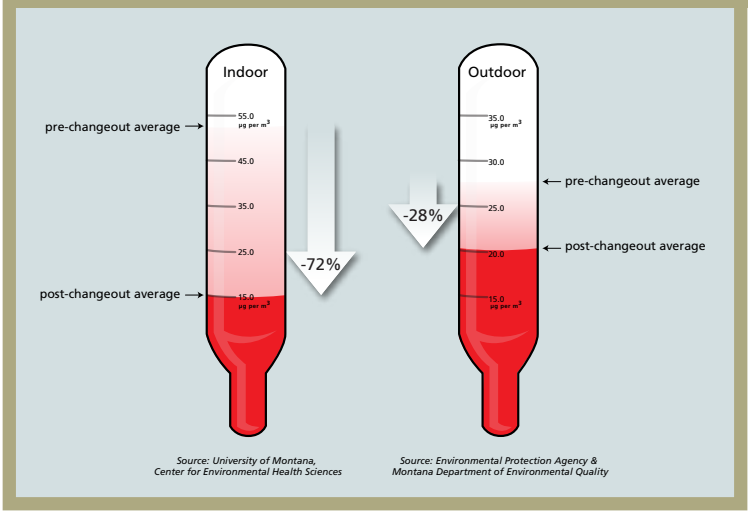
By 2002, Libby's last source of industrial pollution had closed its doors, but wintertime particulate levels remained high. A study released by the University

of Montana in the winter of 2003-2004 found that wood smoke contributed approximately 80 percent of fine particulate matter in the town's immediate atmosphere. While all new stoves and fireplace inserts sold in the U.S. are certified to be low-particulate emitting according to strict standards set by the U.S Environmental Protection Agency (EPA), most Libby homeowners installed their stoves long before the standards took effect in 1992. These older, uncertified stoves can release from 15 to 30 grams of smoke per hour, while new EPA-certified stoves produce only 2 to 5 grams, a 65 percent to 90 percent reduction.

Though the University of Montana report identified the major source of the problem – older stoves and fireplaces – a fix seemed elusive. Removing every old stove and upgrading Libby households with new, EPA-certified units seemed the obvious solution, but the scale of such a program would be larger than anything previously attempted. For residents who had lived through recent dark chapters of Libby's history and felt that inevitably their fortunes had to change, in June 2005 something good finally did happen.

That is when the Hearth, Patio & Barbecue Association (HPBA), the EPA, the State of Montana, and Lincoln County, Montana, announced the creation of a unique partnership and the launch of a wood stove changeout program. These partners provided Libby residents with over $2.5 million in donations and organized a changeout program involving two stages. In Phase I, the program replaced 260 wood stoves in low-income households at zero cost to the homeowner. If a resident rented, the landlord was required to contribute a minimal co-pay, but the resident was not required to contribute to the cost of the new wood stove. Phase I began in June 2005 and ended in April 2007. In Phase II, the program issued households and businesses vouchers that covered the majority of costs for the replacement of 791 stoves. Another 79 wood stoves that were not functioning properly, but that were deemed repairable, were retrofitted or upgraded to meet EPA cer-

Preliminary Data Indicates Significantly Cleaner Air



Haze over Libby in 2004 frequently obscured even the nearby mountains.

tification. Phase II began in January 2006 and ended in June 2007.

Based on a review of preliminary data, Libby residents are now breathing significantly cleaner air – both outdoors and inside their homes. By 2007, average wintertime fine particulate levels in the outdoor air decreased by nearly 30 percent. The results are even more dramatic for indoor air quality with initial research by the University of Montana finding indoor air more than 70 percent cleaner in homes with new, EPA-certified stoves.

The scale of the Libby changeout – 1,130 wood stoves in a little over two years – makes it the premiere example of a successful changeout program. This report documents that experience in the words of those who both led and benefited from the changeout. After a brief introduction to the town's unique history, topography, economy and air quality problems, the following pages detail the Libby changeout program, its results and lessons learned.

The Libby experience demonstrates that a wood stove changeout can significantly and cost-effectively reduce harmful emissions. While Libby is in many ways the poster child for a successful changeout, many other areas can benefit from a similar program. HPBA hopes this report and information on its website – www.woodstovechangeout.org – can help state and local leaders learn how a changeout can make their communities cleaner, safer and healthier.

Many of the original stoves' chimney and venting were not in compliance with installation codes and were replaced.

Introduction to Libby, Montana

Libby, Montana, is a town of about 2,600 residents located in the remote northwest corner of the state, fewer than fifty miles from the Canadian border. Settled by miners and loggers in the late 19th century, the town is divided by the Kootenai River, which snakes through the Libby Valley. Libby is surrounded by mountains, which at elevations of up to 6,000 feet, are formidable barriers to winter winds that might otherwise sweep through the valley, remove the smoke and clear the air in the process. Ironically, these high-shouldered mountains are Libby's greatest liability when it comes to atmospheric pollution.

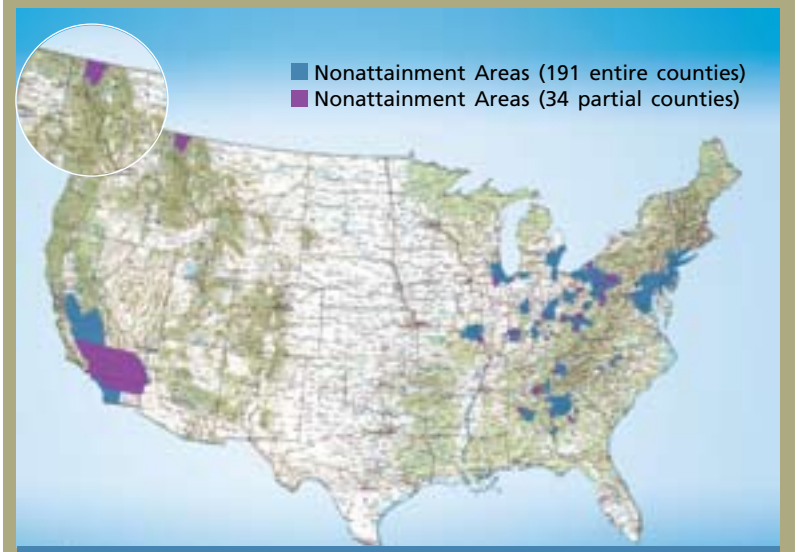
> "Libby is surrounded by mountains, which at elevations of up to 6,000 feet, are formidable barriers to winter winds that might otherwise sweep through the valley, remove the smoke and clear the air in the process."

At the turn of the 20th century, Libby was home to thriving gold, silver and lead mining operations, but it was vermiculite, a mineral used primarily in home insulation, that sustained Libby's economy long after supplies of those metals had dwindled. The vermiculite mining operation, which by some estimates accounted for 80 percent of the world's supply of the ore, ran from 1919 until 1990, and employed a significant segment of Libby's residents. When the mine closed, Libby's economy faltered, and by 2000, 16.3 percent of Libby residents lived below the poverty line; for Lincoln County as a whole, the number was 19.2 percent. That same year, when the national average per capita income was approximately $29,500, Libby's was closer to $13,000.

Today, some Libby residents are employed by timber companies in nearby towns, but when Libby's remaining sawmill closed in 2002, laying off 200 employees, it signaled the end of local industry in the town. The majority of residents now work for the government or in health care, though overall demographics are shifting towards retirees and residents who operate long-distance businesses.

In the 1990s, a combination of industrial pollution and old, improperly maintained wood-burning stoves had sent atmospheric particulate levels in Libby soaring beyond federally mandated standards. Because of Libby's bathtub-like topography, the town is subject to temperature inversions, an atmospheric condition in which a low-altitude blanket of warm air forms atop a layer of cooler air in the valley. Daily winter wind speeds in Libby average less than

2003 $PM_{2.5}$ Nonattainment Areas



For more information on nonattainment areas, visit the EPA's website at www.epa.gov/pmdesignations/finaltable.htm.

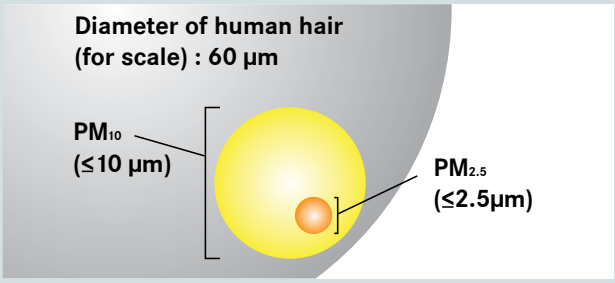
one-half mile per hour, and smoke trapped beneath the blanket of warm air can stay pinned against the ground for days on end. On otherwise sunny winter days, the smoke was so thick that residents often could not make out the Cabinet Mountains, which were clearly visible during the summer.

For years the Lincoln County government had struggled to bring Libby's air quality into compliance with government regulations. The battle began in the late 1980s when Libby fell short of the federal Total Suspended Particulate standards (standards that have since become even more stringent). This continued after the town was designated non-attainment for particulate matter (PM_{10}) in the 1990s; then again after being designated a non-attainment area for fine particulates ($PM_{2.5}$) in 1997. While nearly a decade of efforts to improve air quality made slow, steady progress, Libby's wintertime $PM_{2.5}$ numbers remained at the threshold of standards set by the U.S. Environmental Protection Agency – within acceptable limits, but barely.

In the summer of 2003, anticipating that the town would again run afoul of new EPA standards, which lowered acceptable $PM_{2.5}$ limits from 65 to 35 micrograms per meter, the Montana Department of Environmental Quality approached Dr. Tony Ward of the University of Montana with a map of the United States and a question: what's wrong with this picture?

"We all know about the East Coast, Ohio River Valley, lots of people, lots of industry, lots of cars," Dr. Ward says, recalling his first look at the map. "We've heard about Southern California, the smog...but Lincoln County, Montana, population 2,600? Major industrial areas such as Houston, Dallas, Albuquerque, Salt Lake, Denver...all these major metropolitan areas met the standard when Libby did not."

Even for a healthy population, the respiratory risks involved in breathing fine particles at the concentrations present in Libby would have been



What Is Particulate Matter?

Particulate matter (PM) is a mixture of extremely small particles and liquid droplets, made up of nitrates, sulfates, other acids, organic chemicals, metals and soil or dust particles. Sources of particulate matter can be natural (forest fires or volcanic eruptions) or anthropogenic (car exhaust, cooking smoke, wood stove smoke). PM is one of six emissions – also known as criteria pollutants – regulated by the U.S. Environmental Protection Agency under the Clean Air Act. Particles are grouped by size.

PM_{10}: Particulate matter with a diameter equal to or smaller than 10 micrometers in diameter, but larger than 2.5 micrometers in diameter. A human hair has a diameter of 60 micrometers.

$PM_{2.5}$: Particulate matter with a diameter of 2.5 micrometers and smaller. Because $PM_{2.5}$ can penetrate deeply into the lungs, it is generally considered to be more insidious than PM_{10}.

Source: http://www.greenfacts.org/glossary/pqrs/PM10-PM2.5-PM0.1.htm

Smoke Inversion

Calm winds and the inversion result in poor air quality

Source: Environmental Protection Agency

cause for concern. Libby, unfortunately, was not home to an entirely healthy population.

In 1999, the EPA began investigating the then-closed W.R. Grace mining operation after unusually high numbers of Libby residents were diagnosed with asbestosis, a lung disease caused by exposure to asbestos, and mesothelioma, a rare cancer of the sheathing of the lungs. Vermiculite miners had been all too familiar with the fine dust that was a by-product of the mining process. It clogged their breathing masks and clung to their clothing. At the end of the day, they would return home covered in the dust, effectively contaminating their families with a residue that was only years later identified as containing asbestos. By 2002, the federal government had declared Libby a Superfund hazardous materials site, and cleanup of the vermiculite mine and processing facility is expected to continue until at least 2010. Conservative estimates claim one in eight Libby residents have been affected by asbestos exposure. The Center for Asbestos Related Disease, located in Libby, has treated about 1,400 patients. Because of widespread respiratory disease, residents were even more susceptible to the detrimental effects of elevated particulate levels.

Until the town's last sawmill closed its doors, the source of Libby's pollution problem seemed obvious. But when the town's final source of industrial pollutants was gone and the smoke still did not clear, Lincoln County looked to Dr. Ward and the University of Montana to diagnose what was happening in their valley.

Local officials had a hunch that old, inefficient wood stoves might be a primary source of the remaining fine particulate matter. In large part because Libby is located amid the 2.2 million acre Kootenai National Forest, wood has been the traditional source of affordable heat. There is no natural gas line to Libby, but firewood is plentiful, with permits readily available for residential cutting on 470 square miles of timberland. For most Libby residents, the cheapest way to heat their homes over the long Montana winter was the *only* way to heat their homes.

These most recent chapters of Libby's story have not been kind to its residents. They have experienced economic freefall, devastating health problems and a location that, while in many ways idyllic, also trapped dangerous emissions atop a population that could not have been worse-equipped to deal with them. This last catastrophe was so unkind, in fact, that it must have seemed to some residents inevitable that something good had to happen. And something did.

> “In the past it was just one of those givens that it's fall and the wood stoves were cranking up, and we were going to have to live with smoke all winter.”
>
> -Jerry Marquez

What is a Wood Stove Changeout?

Modern hearth products bear little resemblance to the stereotypical wood stoves of the past. Today's stoves and inserts produce almost no smoke and require less firewood than earlier models. Since 1992, all stoves and inserts sold in the U.S. are certified to be low-emitting, according to strict EPA standards. In comparison tests, older uncertified stoves can release from 15 to 30 grams of smoke per hour while new EPA-certified stoves produce only 2 to 5 grams per hour. Most Libby homeowners installed their stoves long before 1992, and a wood stove changeout seemed the best way to ensure that the community as a whole upgraded to EPA-certified wood stoves.

> "Today's stoves and inserts produce almost no smoke and require less firewood than earlier models."

In general terms, a wood stove changeout program is a voluntary initiative that provides wood stove users the opportunity to upgrade to newer, cleaner, and more efficient stoves. The program typically offers economic incentives, such as rebates, low interest loans or discounts on EPA-certified wood stoves. Participating households must surrender their old stoves to be destroyed and recycled.

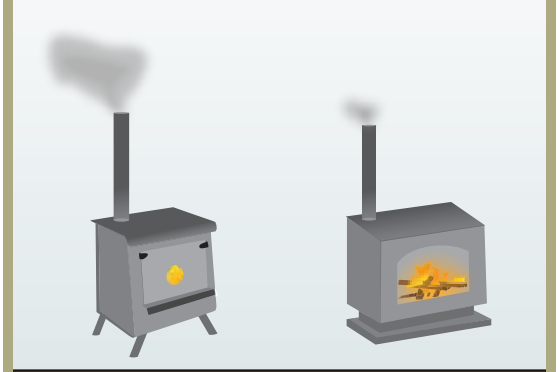
University of Montana researchers studying the town's air quality during the winter of 2003-2004 found that wood smoke contributed, on average, approximately 80 percent of Libby's fine particulates. This breakthrough report identified the major source of the problem; but still, a solution seemed elusive. Residents who saw, and breathed, the effects of the wintertime temperature inversions were not unaware of the health risks of inhaling air that sometimes left them gasping – they simply felt they had no affordable options. For most, it was a vicious cycle. Although some Libby residents had upgraded to EPA-certified wood stoves, progress had been slow, and winter after winter, the majority of residents continued to burn inefficient uncertified wood stoves. Those who upgraded to an EPA-certified model found wood use cut by a third, effectively saving them time and money, while significantly lowering particulate emissions both inside and outside their homes. But an upgrade was, for many residents, a daunting prospect. While there was a seemingly infinite supply of firewood, money was in short supply.

At the EPA and the HPBA, the math was simple: upgrading an uncertified wood stove to a certified unit can cut $PM_{2.5}$ emissions by at least 70 percent – upgrading to a unit burning pellet fuel can reduce emissions even further. The two groups – one an arm of the federal government, the other a trade association of private wood stove manufacturers and dealers – recognized that a wood stove changeout could help tremendously. But the scale of the Libby program would be larger than anything previously attempted.

In Libby where 16.3 percent of residents live below the poverty line, and permits to cut firewood in designated National Forest areas cost $5 per cord

Particulate Emissions in One Hour

Uncertified Stoves	EPA Certified Stoves
15-30 Micrograms	2-5 Micrograms



Overall Efficiency	
40%-60%	60%-80%

(slightly more than a ton) the decision to use wood heat came down to simple economics. Some of the 1,200 uncertified wood stoves in Libby were so old and inefficient that they required between 10 and 16 cords per winter. While permits allow residents to cut up to 10 cords a year, a modern EPA-certified wood stove usually requires about one-third of that. To make matters worse, wood stoves that had been installed improperly or were in a state of disrepair were releasing significant amounts of smoke into homes – an especially unwelcome scenario in a community hit hard by lung ailments. For Libby, a wood stove changeout would be a win-win situation. But how would the town afford it?

Jerry Marquez
Program Coordinator

In preparation for the changeout, Marquez tested nine different wood stoves in his own home.

"People have been burning wood in Libby forever. It's a culture. When people hear they'll be given a new stove that burns less wood, they are skeptical. I can tell you from personal experience that the EPA-certified stoves outperform the old stoves. But motivating the economically subsidized community to apply and participate in the program was a big challenge. We were trying to change a cultural aspect of their lives. It was hard for them to believe that we were giving them a cleaner stove that burns less wood for free."

Dr. James Houck
Vice President,
OMNI Environmental Services

"The bottom line in the Libby area is that there was a respiratory challenge for people who live here. One might be inclined to go in and pull out all the wood stoves and say, 'We've fixed the problem,' but it's much better to understand the problem and find a workable solution because this is a cold climate, and because of a significant low-income population, you have to have an affordable source of heat.

The most important thing achieved in this program is that we've improved the lives of the people who live here. There are children not yet born whose lives will be better because of what's been done."

The Libby Program

Ron Anderson, the Director of Environmental Health and Solid Waste Departments in Libby, recalls being approached by HPBA and EPA in February 2005 with a question: would Libby be interested in a wood stove changeout program if it didn't cost anything? Anderson replied, "Very interested, of course. What's the catch?"

Anderson was invited to the HPBA trade show in Atlanta, Georgia, later that month, where he sat down with representatives from the HPBA, EPA and the State of Montana. They came together with a single goal in mind: to replace every uncertified stove in Libby, and to provide the funding necessary to make that goal a reality. There was no catch, but Anderson had another question: "why Libby?" Anderson himself can now explain why. "The Northwest is full of communities that are virtually identical to Libby in topography – but the thing that is unique about Libby is that we were able to identify the particulate matter source as primarily being from wood stove pollution...we don't have a contributing industry here, we don't have carry-in from other areas. We are rather remote."

The absence of major industry was key to Libby's selection as a model wood stove changeout community, and from early days, coalition members referred to the town as the "perfect laboratory" for a changeout. Because there would be only nominal contributions of $PM_{2.5}$ from other sources, researchers would be able to chart with great accuracy the reduction of $PM_{2.5}$ after the changeout. Paradoxically, Libby was about to benefit from the very characteristics that contributed to its pollution problem in the first place. The valley's topography, a sizeable low-income population, the high incidence of pulmonary ailments and lack of industrial pollution made it an excellent test case for a wood stove changeout.

Because wood stove changeout programs rely on financial incentives, usually in the form of vouchers, to motivate residents to upgrade to EPA-certified wood stoves, adequate funding is central to any program's success. Nowhere could that be more true than in working class communities like Libby. However, the likelihood of a single organization – whether private or governmental – providing the full range of expertise and funding is low. Partnerships are essential. In June 2005, the HPBA, EPA, the State of Montana and Lincoln County announced a partnership that would provide Libby residents with over $2 million in product and resource donations. The scale of the Libby changeout – 1,130 wood stoves in such a short time frame – would make it the premiere example of a changeout program, and the partners would be watching closely for both successes and failures.

Who Gave What	
HPBA cash donations	$173,000
HPBA stove, equipment and in-kind donations	$1,027,000
Environmental Protection Agency	$1,184,000
Lincoln County	$144,700
Montana Department of Environmental Quality	$155,000
Total	$2,683,700

The Lincoln County Department of Environmental Health (DEH) agreed to handle the day-to-day administration of the program, and appointed Ron Anderson, whose 33 years working with air quality control issues in Libby gave him unrivaled perspective on the town and its history of attainment problems, to head up the administrative wing. The Montana Department of Environmental Quality (DEQ) contributed funding for a Program Coordinator, and Jerry Marquez was hired for that position, putting him in daily contact with changeout applicants. In preparation for the changeout, Marquez rotated nine stoves through his own home. "His wife was ready to shoot him if he switched out the stove again," recalls Larry Brockman, head of the EPA's wood stove changeout team. But if changeout participants had questions about their stove, Marquez could answer them with first-hand experience. Lincoln County's DEH has a small staff, and "it was critical that Montana DEQ funded Jerry's position so that there was a real expert" available to residents, Brockman added.

Many partners provided the necessary funding and program support. HPBA and its members donated over $1 million of new wood stoves, hearth pads, chimney liners, installation and training – including 300 EPA-certified wood stoves and accessories to low-income residents. HPBA also funded University of Montana air quality monitoring projects, which ran simultaneously with EPA, Montana DEQ and Lincoln County exterior air quality monitors. Through two grants, the EPA gave the program over $1.1 million, the bulk of which came through a grant dedicated to Libby by the U.S. Congress. The Montana DEQ donated $155,000 to the effort, and Lincoln County added nearly $145,000 of on-going, in kind grants.

More than just money proved necessary for a successful program. HPBA also created a program to train the Program Coordinator and established National Fireplace Institute® (NFI) training programs for all wood stove installers involved with the Libby program. Finally, HPBA helped develop an outreach plan that would communicate the program to the very people who needed to know about it – Libby residents.

Partners decided to structure Libby's changeout in two stages. In Phase I, the program replaced 260 wood stoves in low-income households at zero cost to the homeowner. If a resident rented, the landlord was required to contribute a minimal co-pay, but the resident was not required to contribute to the cost of the new wood stove.

In Phase II, the program issued households and businesses vouchers that covered the majority of costs for the replacement of 791 stoves. Another 79 wood stoves that were not functioning properly, but that were deemed repairable, were retrofitted or upgraded to meet EPA certification.

Phase I

Because 16.3 percent of Libby's population is considered low-income, the first phase of the program focused on making upgrades affordable for those residents, especially because those households were

The National Fireplace Institute® (NFI) is the professional certification division of the HPB Education Foundation, a 501(c)3 non-profit educational organization for the hearth industry. NFI's objective is to increase public safety by establishing meaningful credentials for professionals involved in planning and installing residential hearth appliance and venting systems. NFI, established in 2002, certifies planners and installers in three hearth product categories based on fuel type:

1. NFI Gas Specialist
2. NFI Woodburning Specialist
3. NFI Pellet Specialist

NFI also recognizes individuals who have successfully gained all three NFI Certifications as Master Hearth Professionals. These individuals have reached the highest level of certification in the hearth industry. For more information, please see www.nficertified.org.

Dr. Brad Black
Libby physician and
Lincoln County Health
Officer

"Since 1977, we've had days so extreme, you couldn't see a block ahead of you due to the smoke. Particles suspended in the air, especially from residential wood smoke, blend into bronchial airways. There is a relationship between the levels of particulates and how well the bronchial tubes perform. Effects are multiplied on people with pre-existing respiratory conditions.

Emergency room visitations for respiratory problems were extremely high, but in the last two years we have not seen the accumulation in the air that we have in the past, and hospital visits have decreased."

most likely to be operating outdated, uncertified wood stoves. The average cost for a new, EPA-certified stove is $1,500 – a hefty investment for a household of three trying to get by on less than $30,000 a year. Add the price of installation, an upgraded chimney, and a hearth pad, and that household of three needs to make a $2,900 investment to replace its wood stove.

Breakdown of Phase I Average Costs	
Stove	$1,500
Chimney	$800
Installation (labor)`	$500
Hearth Pad	$100
Total	$2,900

To encourage low-income residents to participate, the coalition structured Phase I around a simple offer. From June 2005 to April 2007, the full upgrade cost was waived for any Libby resident who produced documentation of low-income status. Northwest Montana Human Resources, a non-profit organization in charge of the Low Income Weatherization program in Lincoln County, conducted face-to-face interviews and verified documents. The process purposely did not involve mountains of paperwork for applicants, putting the bulk of the verification process on program administrators.

> "The Libby experience demonstrated that a wood stove changeout can significantly and cost effectively reduce harmful emissions."

In June 2005, Lincoln County coordinated a media event to launch both the Libby wood stove changeout program and the nationwide EPA Great American Wood Stove Changeout Campaign. Montana Governor Brian Schweitzer and other influencers attended. Two days later, potential Phase I applicants attended a stove fair – an informational event at which they could speak with dealers and see what types of EPA-certified stoves would be available for their homes. An educational session was held later in October to advise new wood stove owners about the most efficient use of their stoves.

During the entire run of the program, advertisements in local newspapers, radio and television outlets encouraged low-income Libby residents to apply for the free EPA-certified wood stoves, as did posters and flyers distributed around town. Program staff gave talks at local civic and service organizations, and EPA-certified wood stoves were on display at the Lincoln County Department of Environmental Health. All these efforts were directed at using the single most effective means of spreading a message in a community of 2,600: word of mouth.

Residents were well aware of the health problems associated with the old wood stoves. Dr. Brad Black, a physician practicing in Libby since 1977, says that when he first arrived, "we had days so extreme, you couldn't see a block ahead of you due to the smoke." Black notes that temperature inversions affected not only residents with asbestos-related respiratory problems, but also asthmatic children and the elderly. "Lower respiratory tract problems are common in children...I saw many cases where they had to go to the emergency room due to the intensity of the smoke in the air." But the exterior atmosphere was only half the problem.

Dr. Tony Ward, a researcher with the Center for Environmental Health Sciences at the University of Montana (Missoula), monitored both interior and exterior particulate levels in twenty homes both before and during the changeout. Preliminary data show that after the changeout, interior concentrations dropped from 55 micrograms per cubic meter to 15 micrograms per cubic meter, an average reduction of 72 percent. "Our next step," says Ward, "is to look at the respiratory health of people in the homes."

That is an area Dr. Black, who also serves as the Lincoln County Health Officer, is uniquely qualified to comment on. "Since the changeout," he says, "visible particulates have been almost absent, and I don't see clusters of respiratory illnesses that prevailed in the past." He adds that "healthy people don't get the lung irritation that they used to." Although Dr. Black's observations haven't yet been confirmed by a focused study, his comments do indicate that the Libby changeout has made a positive difference in the health of residents.

However, in February 2005, the positive health effects were only theoretical. The science was solid, but first, residents had to be convinced to participate. And that, it turned out, had more to do with psychology than science. The changeout program required what Program Coordinator Jerry Marquez has dubbed a "cultural change" among Libby residents. "People have been burning wood in Libby forever," he says, and many, like Kyle Moore, resisted putting in an application. "I was skeptical," Moore says. "I didn't know that the new stove would put out the same amount of heat as the old one."

Homeowner Bret Price voiced a different concern. "We hesitated at first because we thought there was going to be a lot of bureaucracy, a lot of hoops to jump through." But local media efforts and stove fairs in Libby eventually convinced both Price and Moore to apply. They were pleasantly surprised. "It took us ten minutes to fill out the forms," Price says. Moore agreed that the paperwork was minimal. And his fears about the EPA-certified wood stove's heat capacity were unfounded. "It turns out that the new stove puts out twice as much heat as the old one," he said.

Yet for some residents there was a deeper issue. Although demographics have changed since the town began to lose its mining and lumber operations in the early and mid-1990s, many Libby residents are ex-miners or sawmill workers, or come from families that have for generations been inextricably linked to those industries. These are people who ex-

Why Use Libby as a Changeout Laboratory?

- **Frequent Use:** Most residents use wood stoves which account for approximately 80 percent of particulate pollution.
- **Topography:** Frequent temperature inversions trap wood smoke over the community.
- **No industrial pollutants:** The absence of competing sources of $PM_{2.5}$ other than uncertified wood stoves.
- **Respiratory problems:** A significant section of Libby's residents suffer from asbestos-related respiratory issues.
- **Low income population:** 16.3 percent of Libby residents live below the poverty line.

Bret Price
Libby Resident

"We were resistant at first. The program was around for quite a while before we decided to apply for the stove, and that was because we kept seeing it advertised in the paper.

There are a lot of differences between the old stove and the new one. The new stove burns consistently over an eight hour period and keeps the house warm all the time. With the old stove we'd get flash heat and then it would cool down. Once we learned how to use the new stove, there was no smoke in the house. I calculated, after about three weeks with the new stove, that I was using 30 percent less wood – and I buy my wood, so it's a pretty good savings over a long winter."

ude a palpable sense of self-reliance, and the ideal of the stout Montana woodsman (and woman) is alive and well in Libby. But that self-reliance was in some cases a hurdle for program administrators, who realized that no one wanted to feel like he or she was taking a handout. As a way of encouraging residents to take action, in February 2006, Lincoln County updated its Air Quality Control Regulation. As of January 2007, it would become illegal to operate an uncertified stove in Libby. Local government did not make the change intending to populate Libby's courthouse with wood stove offenders, but instead to compel Libby residents to comply with adjusted EPA standards. In essence, to give residents just one more reason to upgrade their stoves while the changeout was underway.

Even after residents agreed to the changeout, teaching some how to properly operate the new stove presented a challenge. Jerry Marquez points out that "it is critical in an EPA-certified stove that users burn seasoned firewood, split to the right size." On occasion, installers had to expend considerable time and sweet talk convincing life-long wood stove users that burning methods that worked in older stoves were not necessarily effective in EPA-certified stoves. Several elderly men stubbornly opposed the change because they'd been burning wood all their lives, according to Tom Kurle, an NFI-certified independent wood stove installer. In the end, he won them over with a simple argument. "There's less smoke, less maintenance and less wood needed" in an EPA-certified stove. Put another way, healthier, easier to use and cheaper.

When Phase I wrapped up in April 2007, 260 of Libby's old wood stoves had been replaced with EPA-certified stoves. Bret Price sums it up. "Getting this new stove was like winning a prize," he says. "It's a win-win situation."

Over 1,100 old, uncertified wood stoves were removed and replaced with cleaner-burning, EPA-certified stoves.

Phase II

But what about the nearly 900 old wood stoves that weren't in low-income households? The coalition determined that 791 of those remaining stoves should be replaced by EPA-certified stoves; the other 79 could be rebuilt or refit to adhere to EPA standards.

Because of the magnitude of the Phase II changeout, it was not economically feasible to offer homeowners free wood stoves, but the changeout program did the next best thing. A $985,000 grant from the EPA funded a voucher program that formed the backbone of Phase II. The vouchers came in two denominations: $1,050 for households with uncertified wood stoves; and $1,750 for those with uncertified furnaces, which could be applied to the cost of a pellet furnace or other cleaner burning hearth appliances like a gas stove.

Phase II began in January 2006, and targeted uncertified wood stoves in households or businesses that were not designated low-income. As a result of both

the size of the changeout and the target population, the economics of Phase II differed from those of Phase I. Despite higher average incomes and the common knowledge that the Libby Valley's heavy smoke saturation was a health risk, homeowners still needed motivation to participate. Ron Anderson points out that no matter a resident's income level, "it's common for economic concerns to override health concerns."

However, the need for a changeout was no less urgent than in Phase I. Program Coordinator Jerry Marquez explains: "One question we asked on the voucher application was, 'How many cords of wood are you burning a year?' We found some amazing numbers: 20 cords, 16 cords." The implications were dire – a stove inefficient enough to burn 80 percent more wood than an average EPA-certified stove would be churning out a mass of particulates, costing homeowners money they did not need to spend and eating away at their good health.

As in Phase I, a public awareness campaign was crucial to the program's success. The program used direct mailings, newspaper and radio advertisements, group meetings and a stove fair to kick-off Phase II. Approximately five hundred people attended the fair, where dealers displayed not only wood stoves but also pellet, gas, oil and electric units. Whereas Phase I applicants had a limited range of donated wood stoves from which to choose, Phase II applicants could apply their voucher to a wider variety of heating appliances. Several months later, applicants were invited to an educational session identical to its Phase I counterpart.

From the homeowner's standpoint, Phase II was operationally identical to Phase I. As in Phase I, a home or business owner completed an application and submitted it to the changeout program. After a site visit to confirm eligibility, the homeowner was issued a voucher to defray the cost of an EPA-certified wood stove, and was free to choose any certified heating appliance he or she wished, whether wood-burning, pellet, gas, oil or electric.

Phase II

Value of Vouchers

Voucher Component	Value
Approved heating appliance	$700
Installation of approved heating appliance by certified dealer or independent installer	$350
Removal of stove and decommissioning of wood burning capability	$200
Early application incentive for first 250 applicants	$100
Furnace replacement or upgrade with pellet or gas appliance	$1,400

Judith Goodman
Libby Resident

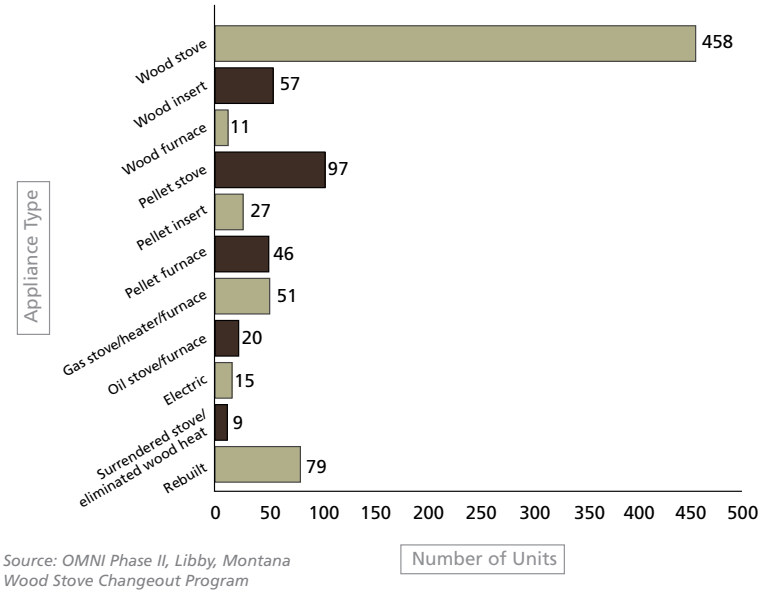
"I've been using a wood stove since moving from Nevada in 2004. I had to feed my old stove a lot of wood, and it just kept eating it. The old stove was quite smoky and would set off the smoke alarm in my home. I have pulmonary disease and my late husband had chronic congestive heart failure. With the old stove, I had to wear a filter mask to clear out the ashes – the new stove burns them down finer, so I don't get all that residual dust. My wood costs have gone down, the new stove is easier to start and stays hot longer, and there's no smell and smoke in the air."

But because Phase II homeowners were required to pay, on average, half or more of the cost of their own changeouts, the program attempted to otherwise reduce costs wherever possible, while maintaining the highest level of quality and safest conditions possible. For instance, homeowners were allowed to install the stoves themselves, but they would lose $350 of the voucher earmarked for professional installation. At an EPA conference in March 2007, Jerry Marquez, by way of explaining the importance of professional installation, mentioned that he had seen a number of pre-changeout, uncertified wood stoves resting on plywood, a clear fire hazard. Wood stove installer Tom Kurle adds, "Half of my installations involved removing stoves that were installed unsafely and improperly. It's a good thing we showed up when we did." Lincoln County offered an additional $100 incentive to the first 250 applicants, and all Phase II participants were encouraged to apply for a $500 Montana state tax credit.

> "It's very gratifying to see the improvement that has occurred in just the last year and a half, from this one project. . ."

The anticipated economic incentives decreased resistance to the Phase II changeout, and there was no coincidence in the timing of Lincoln County's updated Air Quality Control regulation, which was formally adopted in February 2006 to take effect in January 2007, the same date Phase II was scheduled to end. Residents who did not comply with the new regulations could be fined by Lincoln County. When it became clear that some residents were not going to make the deadline, administrators briefly extended the program and the county opted not to levy fines as long as residents demonstrated an effort to upgrade their stoves by applying to the changeout program. The minority who refused to upgrade were subject to a fine of $25 for every day they burned an uncertified wood stove. "We got compliance before too long," says Anderson.

Number of Phase II Installations by Type, Rebuilds and Surrenders



Source: OMNI Phase II, Libby, Montana Wood Stove Changeout Program

From September to November 2006, the program experienced an upswing in voucher applications. It was not entirely unexpected, but administrators had tried to avoid a last-minute rush by mounting an advertising program over the summer. Residents were encouraged to apply immediately, since the program would no longer accept applications after November 1. But even with the new air regulations and the Phase II deadline looming, homeowners waited until September to apply. That month, the program received 93 voucher ap-

plications, the most active month to date. But that was just the beginning. "We had 260 applications in October and November," says Jerry Marquez. "In the summertime, school is out, fishing is good, camping is phenomenal. Nothing really happens until the kids go back to school. Then families start focusing again on their responsibilities."

Because of the boom and bust nature of the application process, administrative and governmental flexibility were key to the program's success, according to Ron Anderson. "It was an evolving process right from the start. The work plan needed to be changed as new problems arose...and you need the support of both community and government – local, state, and federal, if applicable."

Perhaps the greatest endorsement of the program's success came from someone intimately familiar with both Libby and the effects of the changeout program. Dr. James Houck, Vice President of OMNI Environmental Services, co-authored a comprehensive report on the Libby changeout. "The bottom line in the Libby area," he says, "is that there was a respiratory challenge for people who live here. The most important thing achieved in this program is that we've improved the lives of the people who live here remarkably. There are children not yet born whose lives will be better because of what's been done."

Other Incentives

Local regulation and state support aided the effectiveness of Libby's program.

Air Quality Control Regulation

Libby's 30-year history of EPA non-attainment was accompanied by a series of air control regulations enacted by the Lincoln County Environmental Health Department. These State Implementation Plans (SIPs), created to foster compliance with the federal Clean Air Act, laid out pollution-reducing guidelines for businesses and private citizens in Libby.

Until the late 1990s, local mining and lumber industries were the main sources of pollution for three seasons a year – but even with those industries operating in Libby, residential wood stoves were known to be a major source of pollutants in the winter months. In Libby, pre-wood stove changeout SIPs typically allowed residents to use a uncompliant wood stove if it was the home's sole source of heat. However, to comply with the most recent EPA adjustment to $PM_{2.5}$ standards, Lincoln County removed the "sole heat source" exemption. "We felt we needed to put a foot down," says Anderson. "We go to the community and say, 'Okay, January 1 of 2007, you can no longer burn a non-certified stove. But here's what we can do to help you. We have a wood stove changeout program.'" Thus, the updated Lincoln County Air Quality Control Regulation worked in symbiosis with the wood stove changeout program – the regulation pressed residents to take advantage of the changeout, and the changeout made the stricter regulation possible. Residents still burning a uncompliant wood stove after New Year's 2007 were subject to a $25-per-day fine.

State Tax Credit

Since January 2002, Montana taxpayers who install EPA-certified wood stoves in their homes are entitled to a state tax credit equal to the cost of the unit and installation, up to $500. Residents can apply for the credit at any time within four years of installation of the EPA-certified wood stove. All Phase II wood stove changeout participants were encouraged to apply for the credit.

Results

Based on preliminary data, Libby residents are now breathing significantly cleaner air – both outdoors and inside their homes.

Federal and state monitors have been testing Libby's outdoor air quality since the beginning of the decade. This continuous testing allows officials to contrast particulate levels from 2000-2005 (referred to in this report as the "pre-changeout" period) with levels from 2007. Since most Libby changeouts occurred in 2006, data for this transitional year is excluded. During predominantly winter months in Libby – typically November through February – air monitors registered average fine particulate ($PM_{2.5}$) levels of 28.1 micrograms per cubic meter ($\mu g/m^3$) from 2000-2005. In 2007, average $PM_{2.5}$ levels for these winter months dropped to 20.3 $\mu g/m^3$—a 28 percent reduction compared to the pre-changeout years. For January, historically Libby's dirtiest winter month, outdoor $PM_{2.5}$ levels decreased by 37 percent compared to the pre-changeout period.

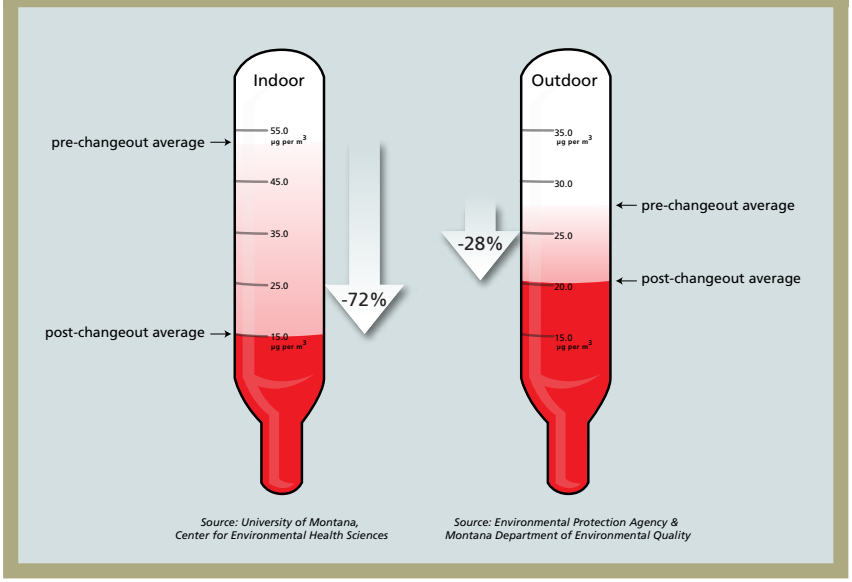
The results are even more dramatic for indoor air quality. Dr. Ward conducted before and after measurements of indoor particulate concentrations in 21 Libby homes. Prior to changeout, indoor $PM_{2.5}$ levels averaged over 53 $\mu g/m^3$. After stoves in those homes were replaced with EPA-certified units, particulate concentrations dropped to 15 $\mu g/m^3$—a 72 percent reduction. "This is one of the unexpected results of the program," Ward says. "A lot of focus has been placed on the ambient environment… but this data is a pretty significant reduction of $PM_{2.5}$. The next step is for us to look at the health effects of these dramatic reductions."

While Ward's research is still under peer review by the scientific community, Libby residents and the population of the Greater Libby Valley have already noticed improvements.

Carol Cox, a Libby resident and wood stove changeout participant, lives with her husband, Curt, and two daughters. Both girls have asthma, and even before the changeout, the Coxes knew that their uncertified wood stove contributed to their daughters' respiratory problems. "With the old stove we dealt with a lot more smoke in the house," she says. "It tended to aggravate their systems and they would get colds more often. This winter, with the new stove, it's not smoky and they have only been sick once."

Kyle and Kimberly Moore, parents to son Vincent, echoed those sentiments. "The new wood stove is less dusty than the old one," they said. "With the old wood stove you're just coughing so much, and with the new one you're not getting sick as much. With the old wood stove, you'd wake up with congestion. When our son was really young, you could hear this

Preliminary Data Indicates Significantly Cleaner Air

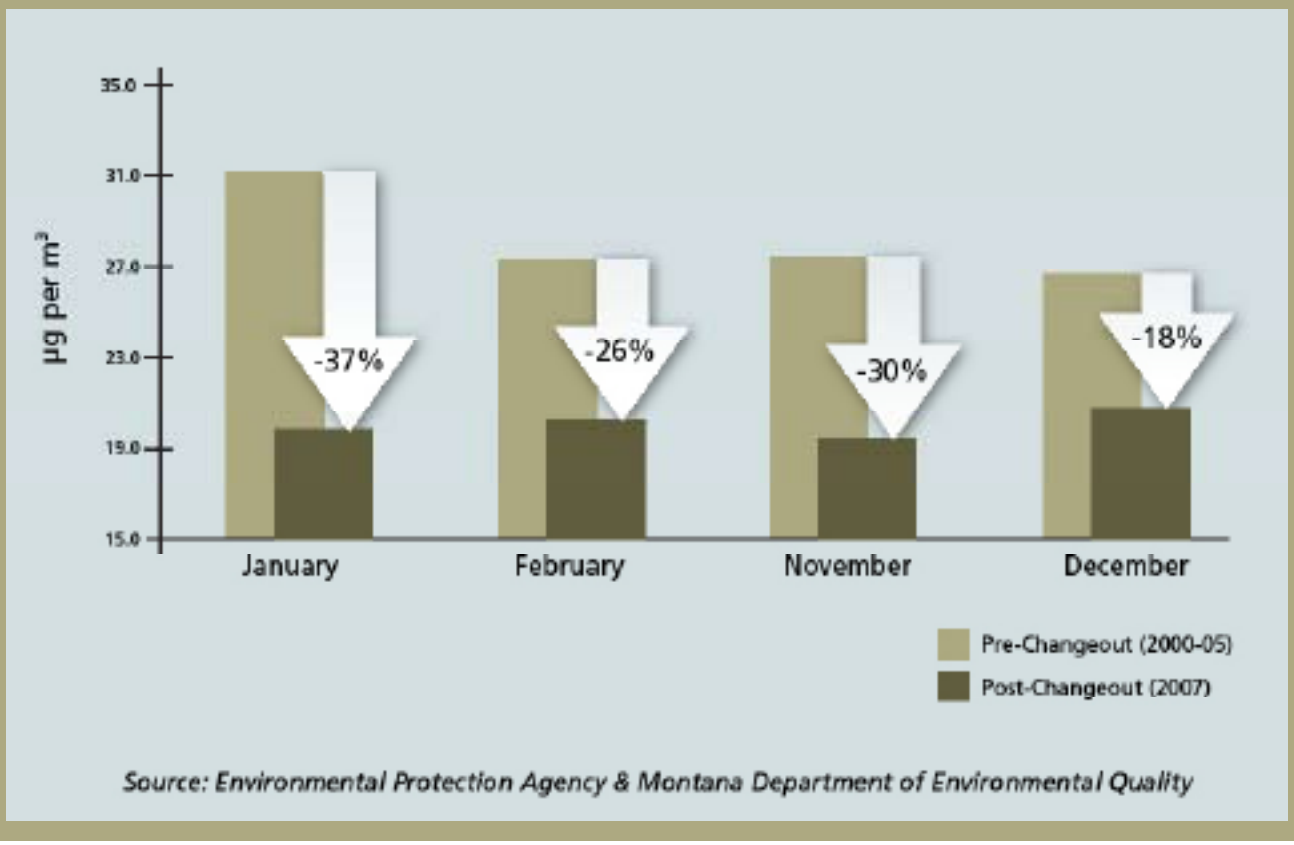


phlegm when he was sleeping, and it's completely gone now. He sleeps much more soundly."

Curt Cox concurs with his wife that their daughters' health has improved as a result of the changeout, and he points to another, perhaps unexpected, benefit of the changeout program: he now has more time to spend with his children. "I think we burn maybe four cords a year, at the most, maybe three, compared to eight or nine previously. If I'm not out there busting firewood on the hill, it means we've got more time to do what we want," he says. "Just having that extra time is a benefit. We get to go to church more often. We get to spend more time together. We like to play dominoes."

According to the National Fire Protection Association, from 1999 to 2001, 33 percent of wood stove-related fires were caused by creosote buildup in chimneys. Because EPA-certified wood stoves burn more efficiently, they produce less creosote. In a wood stove changeout program, NFI-certified installers ensure that every EPA-certified wood stove is vented properly, and in the safest manner possible. While it is still imperative that homeowners clean their chimneys annually, the installation of an EPA-certified wood stove greatly reduces creosote buildup, and the likelihood of a house fire.

Monthly Fine Particulate ($PM_{2.5}$) Levels for Winter Months in Libby



Lessons Learned

Wood stove changeouts work.

The overarching goal of a wood stove changeout is to reduce interior and exterior emissions of fine particulates. In Libby, accomplishing that goal resulted in a marked improvement in local air quality, which is already paying off in health benefits for residents. In many communities like Libby, a changeout is one of the most cost-effective methods of reducing fine particulates, and an upgrade to EPA-certified wood stoves offers homeowners ancillary safety and efficiency benefits.

Secure funding and establish partnerships.

It is essential to locate sources of funding from a combination of local, state and federal governments, and to reach out to private organizations like the HPBA. A partnership that spans government and the private sector should include organizations not only willing to offer funding, but also those that can offer expert guidance in the areas of air quality monitoring, wood stove installation and operation, and local socio-demographics. Securing the support of local government is essential. Ideally, local government should be a key partner in the program's design and execution from the initial stage of development.

Invest in scientific monitoring before, during and after the changeout.

A partnership with a university or independent scientific monitoring organization makes the objective evaluation of a changeout possible. Funding sources as well as citizens themselves will be able to compare objective findings and draw their own conclusions about the success of the changeout program.

Design the program to include options based on the socioeconomics of the participants.

Knowing the community, its makeup, and character is essential for planning a wood stove changeout program. It is important to understand the factors influencing wood stove use, including housing types, the local economy, population age characteristics, heating alternatives, fuel costs and availability, local traditions and climate. If the stoves are not considered appropriate – because they are too big or small, too expensive or plain, or perceived to have some other problem – then residents will not participate in the program.

Carefully consider individual economics.

Changeout participants should be made aware of all costs that are not covered by the program itself. Whenever possible, offer financial incentives to participants and try to include the costs of installation and non-wood stove materials like hearth pads, piping and chimney liners into those incentive packages.

Outreach and education programs are critical to the long-term success of the changeout.

The importance of public outreach and education cannot be overstated. From the initial phase of explaining the need to reduce wood smoke to a sustained campaign educating eligible stove operators on the details of the program, successful changeouts require comprehensive communications plans. In addition, new EPA-certified wood stoves are operated, and perform, differently than typical older uncertified stoves. Offering changeout participants both in-home and community-based opportunities to learn first hand how to operate EPA-certified stoves is key to efficiently heating their homes while decreasing particulate levels in the atmosphere.

Emphasize the safety benefits of upgrading to an EPA-certified wood stove.

A wood stove changeout program insures that wood stoves are installed safely. National Fireplace Institute-certified installers who have worked in changeout programs say that many old uncertified stoves have been improperly installed or are in such disrepair they can be hazardous to users. Additionally, uncertified wood stoves produce more creosote than EPA-certified models, which can lead to excessive buildup in chimneys and a greater fire hazard.

The National Fire Protection Association estimates that in 2001, 33 percent of wood stove-related home fires were the direct result of homeowners' failure to perform annual chimney maintenance.

Consider the seasonal aspect of wood stove sales when planning a changeout program.

Traditionally, wood stove sales spike in the fall. During the spring and summer, few homeowners think about purchasing a new wood stove, but when the weather turns cool, wood stove dealers can be flooded with orders. When planning a wood stove changeout, consult with local dealers to determine the best way to avoid bottlenecks. Expect to receive a large number of applications after any outreach event, and plan accordingly. If necessary, offer a financial incentive for applicants to apply in the "off-season" if installers are concerned about their ability to handle high-volume applications in the fall.

Stay flexible.

Any changeout program that operates on a community-wide scale, and on an aggressive timetable, has to remain flexible. Focus on the final goal of completing the changeout, and endow the program coordinator and program manager with the authority to make adjustments to the program's plan.

Budget for proper administrative staffing.

Any changeout program needs a local program manager who knows the community and its specific characteristics and can oversee the administrative details of the program, including coordination with other partners. Ideally, the program administrator should be familiar with the socio-demographics of the area affected by the changeout program. Because of time constraints, the logistics of scheduling eligibility evaluations and installations, and the volume of administrative paperwork generated by a changeout program, the program manager should be supplemented by an appropriately-sized administrative staff.

Ron Anderson
Lincoln County Sanitarian and Director, Environmental Health & Solid Waste Department

"The changeout program was an evolving process right from the start. My advice is: establish a blueprint that addresses the issues you can identify, but remain flexible. You'll need the support of both community and government, both local and state – and federal, if applicable. Educating people helps entice them to participate in the changeout, but it's common for economic concerns to override health concerns. For that reason, you'll need both financial incentives and enforcement, like the Air Quality Regulations, to put some teeth into it.

I was born and raised here, and have worked for Lincoln County for thirty-three years. As a county employee, this is the most rewarding project I've worked on in my career. More important, by being a resident here, I've lived through all the smoke events that all the residents have lived through – be it the mill or chimneys or timberland burning, whatever the source may have been. Smoke has been a continual presence in this community. It's very gratifying to see the improvement just in the last year-and-a-half, from this one project. A lot of times a public project winds down and you don't have much positive feedback. This has been different. People I've known all my life say that now things are different. They bought into it, they see the results, and they are appreciative.

And that's very gratifying to me."

Dr. Tony Ward
Center for Environmental Health Sciences, University of Montana

"The changeout has been a Herculean undertaking, and working on this program has been an amazing experience. Everyone came together to solve this problem – and it worked. This is the ideal interface between science and policy."

Is a Changeout Program Right for Your Community?

The Libby experience demonstrates that a wood stove changeout can significantly and cost effectively reduce harmful emissions. While not every area of the country needs a changeout campaign, many other communities – experiencing one or more of the following characteristics – may benefit from similar initiatives:

- Non-attainment designation by the U.S. EPA for fine particles, also known as $PM_{2.5}$.
- High levels of wood smoke and other emissions from residential wood stoves.
- A local topography that traps smoke over the community for long periods.
- A large number of households burning uncertified wood stoves.
- A low-income population that would recognize health benefits from a changeout program.

Wood stove changeouts can work in regions of all shapes and sizes. While Libby is in many ways the poster child for a successful program, many other communities – including the following – have implemented effective programs. To learn more about starting a changeout campaign in your area, visit www.woodstovechangeout.org.

1 Delta County, Colorado SEP-Funded Wood Stove Changeout

Delta County, Colorado, much like Libby, is located in a valley subject to wintertime temperature inversions that trap wood smoke for days at a time. Once home to a Louisiana-Pacific Corporation plant, Delta County instituted a wood stove changeout program using funds secured from an EPA ruling against the LP plant in the 1990s. As part of the settlement, Louisiana-Pacific agreed to enact a Supplemental Environmental Project (SEP), a voluntary environmental improvement project performed by a company found to be in violation of an EPA regulation.

Louisiana-Pacific's SEP provided grant monies, administered by the state of Colorado Attorney General, to Delta County, which used the $195,000 to institute a rebate program for low-income residents who want to upgrade to an EPA-certified wood stove. Smaller discounts are available for other community members.

Since its kickoff in 1995, Delta County has distributed $108,000 to fund the changeout of 162 wood stoves.

2 Great Lakes States Wood Stove Changeout

In 2000 and 2001, the North Central Hearth Patio & Barbecue Association (NCHPBA) partnered with the HPBA, other industry affiliates, the EPA and state and local governments in Wisconsin, Minnesota and Michigan to launch the Great Lakes States wood stove changeout program. Conducted on a massive scale, the program targeted wood stove users in Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, western New York, North Dakota, Ohio, South Dakota, Wisconsin and the Georgian Bay region of Ontario.

The program first recruited 124 retailers and 57 manufacturers to participate, and then turned its attention to wood stove users in the Great Lakes area, launching a public awareness campaign that educated users about the effects of wood smoke on both air and water quality.

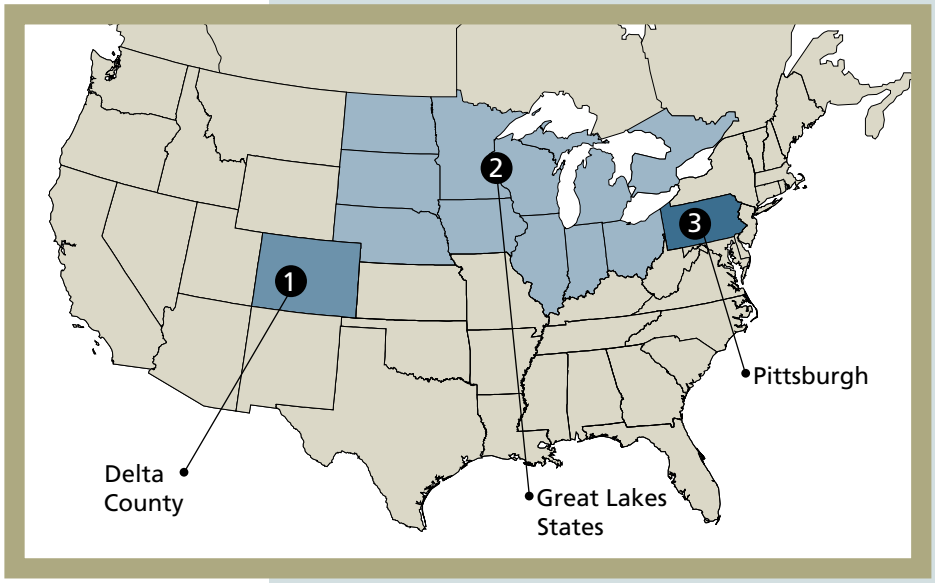
By the end of the three-month publicity blitz, 2,295 consumers called a special information hotline; the changeout website received 200,000 hits; and, most importantly, 1,287 users reported upgrading to EPA-certified wood stoves, gas hearth products, and pellet stoves.

3 Pittsburgh, Pennsylvania Wood Stove Changeout

In 2005, the EPA awarded the Southwest Pennsylvania Air Quality Partnership a grant for $100,000, which was supplemented by an $80,000

grant from the Allegheny County Health Department. The grants funded a wood stove changeout in the Pittsburgh area that was remarkably similar to Libby's in both design and lessons learned.

The grants were applied in two phases, the first targeting low-income residents of 11 counties surrounding Pittsburgh, who received $2,000 vouchers to apply to new, EPA-certified wood stoves; the second phase offered other residents discounts on EPA-certified wood stoves at participating retailers.



Several important lessons emerged from the Pittsburgh program, some of which mirrored lessons learned in Libby. First, the importance of local program administration was paramount, and Allegheny County supplied staff and support, a system that also proved invaluable in Libby. Second, the Pittsburgh program's public awareness efforts began just prior to kickoff, which led to confusion among applicants over who was eligible for the $2,000 vouchers and who wasn't. Program coordinators agreed that the awareness campaign should have begun sooner. Third, the Pittsburgh program began in the fall, traditionally the busiest time of year for wood stove dealers. Dealerships found themselves in some cases overwhelmed by demand, an issue echoed in the application spike during the fall of Libby's Phase II changeout.

Ultimately, the Pittsburgh program changed out 200 wood stoves in the "discount" portion of its program, and 31 low-income users applied their $2,000 vouchers toward EPA-certified wood stoves.

wood stove CHANGEOUT

Changeout Checklist

The following components will help develop an effective program in your area.

- Broad Coalition of Interested Stakeholders
- Adequate Funding
- Effective Financial Incentives
- Public Outreach and Education
- Targeted Regulatory Requirements
- Administrative Resources
- Identification of Uncertified Stoves
- Proper Disposal and Recycling of Old Stoves
- Air Quality Monitoring

Acknowledgements

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