

Opportunities for Air Quality Improvement in the Fairbanks  
North Star Borough

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## **Executive Summary**

Technology improvements have allowed better and more detailed measurement of the impact of air pollution on human health. Recent studies indicate that the effects of air pollution on breathing disorders and premature deaths may have been underestimated. In fact, the American Lung Association, reports that more than 800 scientific studies relating to the affect of airborne particulates on human health were accomplished between 1996 and 2001. One of these studies promotes the idea that overall mortality increased by 0.5% for every increment of 10 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) of exposure to course particulate matter measured the day before death. An estimate by Dr. C. Arden Pope III from Brigham Young University estimated that exposure to fine particulate matter pollution can decrease human life by 1-3 years depending upon the age at which the susceptibility to the effects of air pollution begins. The United States government recognizes the negative impacts of air pollution on human health and the environment and has since the 1950's implemented policies regulating sources of air pollution. The US Environmental Protection Agency (EPA) was created to enforce the regulations put forth in the 1970 Clean Air Act (CAA). The CAA requires the EPA to revisit air quality standards every five years in light of the most recent scientific information available. As a result of that charge, the nation's air quality standards have continued to be refined over the past 40 years. Most recently, in 2006, the air quality standards for exposure to fine particulate matter were tightened based on more conclusive evidence of the negative effects of fine particulates on human health. These revised standards, enforced by the federal government, have caused Alaska, along with the rest of the country to evaluate available data and to declare themselves as either compliant or non-compliant with the new 2006 standards.

The State of Alaska, using the best available data, declared the Fairbanks North Star Borough (FNSB or Borough) and surrounding areas as being non-compliant with the 2006 standards due to particulate matter exposure which surpassed those allowed by law. Some negotiation has taken place between the EPA and the Borough resulting in the boundaries of the non-compliance area being reduced down to what the data supported. The EPA recently published the compliance status of all US states in the Federal Register triggering a 5-year timeframe to come into compliance for those cities and counties deemed non-compliant. The Borough is one such area and is now faced with difficult questions such as:

- What are the sources of fine particulate matter in the Borough?
- Which of these sources can be fiscally addressed and reduced?
- Does existing data really identify what is happening?
- Does it show where the pollution is coming from?

- What are the social, legal, financial impacts of the policies required to become compliant?

The sheer number of stakeholders also complicates the issue of how to become compliant with fine particulate exposure standards. Stakeholders, or interested parties, range from large (federal and state governments, industrial plant operators, commercial entities) to small (rural communities, homeowners, vehicle/equipment operators). Each stakeholder has a series of benefits and disbenefits that affect their viewpoint on the matter. Governments are tasked with the general welfare of the people. This is a broad term that ranges from human health and welfare to establishing and maintaining jobs. Despite the complexity of the interested parties, the State of Alaska, the Alaska Department of Environmental Conservation (ADEC), and the Borough are on a federally mandated timeline to come into compliance with national air quality standards. This timeline begins in April 2009 and ends no later than April 2014; the state is given three years to develop an improvement plan and an additional two years to enact it.

Prior to the tightening of the air quality standards in 2006, the Borough was compliant with the fine particulate matter criteria, but many locations throughout the country were not. Only after the revision in 2006 did the Borough become non-compliant in this category. The Borough experienced a similar situation in the early to mid-nineties when it was found non-compliant with the federal carbon monoxide (CO) standards. Through successful implementation of a corrective CO plan, the Borough was able to become compliant with the standards albeit after missing a series of EPA deadlines and negotiating extensions for compliance.

There are a number of communities throughout the country who are in the middle of completing corrective actions for compliance with fine particulate matter who have gained valuable information that the Borough can take advantage of. Through extensive data gathering and studies, the Borough has been able to get a preliminary assessment of the main sources of fine particulate exposure in the local area. This last winter the Borough spent hundreds of thousands of dollars to expand upon relevant data and study of the issue beyond what has occurred over the past several years. The full extent of this data is not available at the time of this report; nevertheless, this data will help the Borough pin point where the most cost effective solutions can be implemented.

Large industrial producers of particulate matter such as coal fired power plants and diesel fired power plants, have established regulatory controls and emissions monitoring equipment that gives a fairly accurate picture of their emissions. Modeling of the air shed also gives insight into the impact of these plants. The ADEC and the Borough have a pretty good estimation on what

contribution to the fine particulate problem these plants make. In addition to industrial plants, there are other less obvious sources that are significant contributors to the fine particulate exposure in Fairbanks. Other sources include commercial and residential heating and mobile sources such as vehicles and equipment. Using past data gathered by Borough, it is apparent that residential heating and large diesel vehicles are major contributors to fine particulate emissions. This data is consistent with findings in other communities throughout the country also faced with fine particulate standards non-compliance.

This report will establish that these two sources of fine particulate emissions (residential heating and large diesel vehicles) can be singled out as areas for improvement in air quality. The Borough has a number of programs available to them that can positively affect the amount of emissions generated by these sources. Local policy and regulation of these sources is likely to be a significant component of the Borough's State Implementation Plan (SIP) that they are required to submit by April 2012. Regulation in these two areas is likely to be met with opposition from many stakeholders and with no surprise. The Borough resides in the far north, an area that has not only a high cost for heating fuel but also a need for homes to be heated for eight months out of the year. A significant number of large diesel vehicles are also utilized in support of the petroleum and construction industries. Nevertheless, with stakeholder involvement in the decision making process, the Borough can achieve desired results that include 1) reduced exposure to fine particulate matter for the general health and welfare of the people and 2) reaching an attainment status to avoid fines, loss of funding, and further involvement by the federal government. This report provides an introduction and background to the problem, analyzes available data, identifies stakeholders, assesses benefits/costs, and address alternatives for improvement in local air quality.

## **Introduction**

Meuse Valley, Belgium: Donora, Pennsylvania, USA: London, England: All three of these locations are diverse and spread out over thousands of miles and yet they have something in common. All three of these locations are early examples of the hazards of air pollution. From 1-5 December 1930 in the Meuse Valley in Belgium industrial pollution contributed to the accumulation of air pollutants including sulfur dioxide, sulfuric acid mists, and fluoride gases. The last two days of the event had a recorded 60 deaths, ten times the normal mortality rate in this area. In the small southwestern Pennsylvania town of Donora, a late October inversion settled in the valley in 1948. The inversion contributed to an extreme air pollution event fed by contaminants from coal-fired home and industrial facilities, metal works, coke ovens, iron industries, and a zinc retort refinery. Seventeen people died on Sunday, 30 October and three more died within a week's time. The death rate of this event was six times the normal mortality rate for the town of 14,000. London, England experienced a dense fog December 5-9, 1952. Pollution resulting from coal-burning stoves, power plants, and factories combined with the foggy weather resulted in about 3,000 deaths the first three weeks of December. While initial reports attributed the increased death rate to influenza, a recent study estimates that 12,000 excess deaths occurred during this time as a result of acute and persistent fog coupled with pollution levels that were between 5-19 times the regulatory standards of the time.<sup>1</sup> The reports from these cities are some of the early indicators of the severe effects that air pollution can have on human health.

It is estimated that humans take about 25,000 breaths a day. Breathing polluted air brings toxins and small particulates into our lungs that affect our cardiovascular system. Significant exposures to air pollution can make us sick decreasing our health and well being. It can even contribute to diseases and shortened life spans. Air pollution can also damage trees, crops, plants, animals, bodies of water, and other vital parts of our ecosystem. Air pollution can damage buildings, vehicles, infrastructure, and equipment. The effects of air pollution have become better understood since the 1930's in Meuse Valley Belgium. Despite the things that are understood about air pollution, it is still a difficult problem to control. It is a challenge that everyone faces today and that the next generation will face tomorrow.

The Borough, nestled in the interior of Alaska, is considered a beautiful area located adjacent to some of the nation's most well preserved natural environment. Even here in the Borough there are challenges with air pollution. This report will explain the air pollution issue faced in the Borough by giving a background on air quality, discussing causes, identifying the stakeholders,

analyzing the feasibility of alternative opportunities for reducing air pollution, and concluding with some areas for continued focus.

## **Background**

The Air Pollution Act of 1955 was the first federal legislation involving air pollution. The Act provided funding for research into the potential causes and effects of air pollution. The nation's second piece of air pollution related legislation, the Clean Air Act of 1963, was able to take action based on the research results achieved by funding from the Air Pollution Act of 1955. The Clean Air Act of 1963 was the first federal legislation that was directed toward air pollution control. It established a federal program with the U.S. Public Health Service and authorized research into techniques for monitoring and controlling air pollution. Shortly after the Clean Air Act of 1963, the Air Quality Act of 1967 was enacted to further develop federal government involvement in air quality control by enforcing standards on interstate air pollution transport. As part of the enforcement of these standards, the federal government conducted its first extensive ambient monitoring studies and stationary source inspections. The Air Quality Act of 1967 also expanded studies of air pollutant emission, inventories, ambient monitoring, and control techniques.<sup>2</sup>

The 1970 CAA resulted in a major shift in the federal government's role in air pollution. According to the EPA published the "Plain English Guide to the Clean Air Act"<sup>3</sup>, the Act developed broader federal and state regulations controlling emissions from both stationary and mobile sources. Four major regulatory programs overseeing stationary sources were initiated under the CAA; the National Ambient Air Quality Standards (NAAQS, pronounced "knacks"), SIPs, New Source Performance Standards (NSPS), and National Emission Standards for Hazardous Air Pollutants (NESHAPs, pronounced "knee-shaps"). Enforcement authority of the federal government was significantly expanded. While not part of the CAA, in 1971 the National Environmental Policy Act (NEPA) established the EPA in order to implement the various requirements included in the CAA.

The CAA has been amended several times since 1970, including 1977 and 1990. Major amendments added to the CAA in 1977 included provisions for the Prevention of Significant Deterioration of air quality in areas that were compliant with the NAAQS. The 1977 amendments also contained requirements pertaining to sources in non-attainment areas. Both 1977 amendments established a major permit review requirement to ensure attainment and maintenance of NAAQS. The 1990 amendments also increased the authority and responsibility of the federal government with respect to air quality policy and enforcement. New regulatory

programs were authorized for control of acid deposition (acid rain) and for the issuance of stationary source operating permits. The NESHAPs were incorporated into a greatly expanded program for controlling toxic air pollutants. Provisions for attainment and maintenance of NAAQS were substantially modified and expanded. Another portion of the 1990 amendments included provisions regarding stratospheric ozone protection. Table 1 provides a summary of names, dates, and key points for CAA policy.

Table 1 – Clean Air Act Legislation Summary

Title	Year	Key Points
Air Pollution Act	1955	First federal legislation. Primarily authorized funding for research in air pollution.
Clean Air Act	1963	First federal legislation regarding air pollution control. Authorized funding for research on how to monitor and control air pollution.
Air Quality Act	1967	Enforcement proceedings for interstate air pollution transport were made into law. Studies for monitoring and control of air pollution are expanded.
Clean Air Act	1970	Four regulatory programs established: (NAAQS, SIPs, NSPS, and NESHAPs). Enforcement authority expanded.
National Environmental Policy Act	1970	EPA established in order to implement various requirements of the CAA.
Clean Air Act (Amended)	1977	Created provision for PSD of air quality in areas that had attained NAAQS. Contained requirements for sources in non-attainment areas for NAAQS. Created permit review requirements.
Clean Air Act (Amended)	1990	Authorized regulatory programs for acid rain. NESHAP program expanded to include toxic air pollutants. Established permit program requirements.

The EPA's mission is to protect human health and the environment. To achieve this mission the EPA has implemented a number of programs that focus on:

- Reducing outdoor, or ambient, concentrations of air pollutants that contribute to smog, haze, acid rain, and other air quality problems
- Reducing toxic air pollutant emission sources for pollutants that are known to, or suspected of, causing cancer or other serious health effects, and
- Phasing out the production and use of chemicals that destroy stratospheric ozone

The six common air pollutants regulated by the EPA, referred to as criteria pollutants, include: particle pollution, ground-level ozone, CO, sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), and lead. The EPA considers particle pollution and ground-level ozone as the most widespread health

threats.<sup>4</sup> Of the pollutants regulated by the EPA, this report will solely examine fine particle pollution. Fairbanks has experienced challenges with CO in the past and is currently in a CO maintenance status with the EPA due to successful implementation of a SIP. Other than fine particle pollution, the Borough is attaining NAAQS on the criteria pollutants.

Criteria pollutants are regulated by setting permissible levels of exposure that are based on human health or environmental protection criteria. The set of limits based on human health are called primary standards. Another set of limits based on environmental and property damage are called secondary standards. Geographic areas that are in compliance with primary air quality standards are designated as attainment areas; areas that do not meet primary air quality standards are designated nonattainment areas.

The EPA has defined particulate matter (PM) as a “mixture of extremely small particles and liquid droplets.” Health professionals pay attention to particulate size because very small particles are capable of passing through the nose and mucus membranes of the nostril and entering the lungs. Once in the lungs, the particulates can contribute to asthma and sicknesses, diseases, and other health related problems including pre-mature death.<sup>5</sup> The EPA utilizes two sizes of PM as standards of measurement; coarse particulate matter (PM<sub>10</sub>) is defined as particulates that are less than 10 micrometers in diameter. PM<sub>10</sub> particulates primarily come from road dust, agriculture dust, river beds, construction sites, mining operations, and similar activities. Fine particulate matter (PM<sub>2.5</sub>) is defined as particulates that are less than 2.5 micrometers in diameter, which allow them to be lodged deep in the lungs or directly in to the bloodstream via the lungs.<sup>6</sup> PM<sub>2.5</sub> particulates are generally a byproduct of combustion. Examples of PM<sub>2.5</sub> sources include power plants, large vehicles, wood/coal burning stoves, and wild-land fires<sup>7</sup>. For reference a micrometer, or micron, is one millionth of a meter or one-tenth the thickness of a human hair. The primary standards used by EPA to determine attainment and non-attainment are based on 24-hour averages that are measured at the PM<sub>10</sub> and PM<sub>2.5</sub> levels.

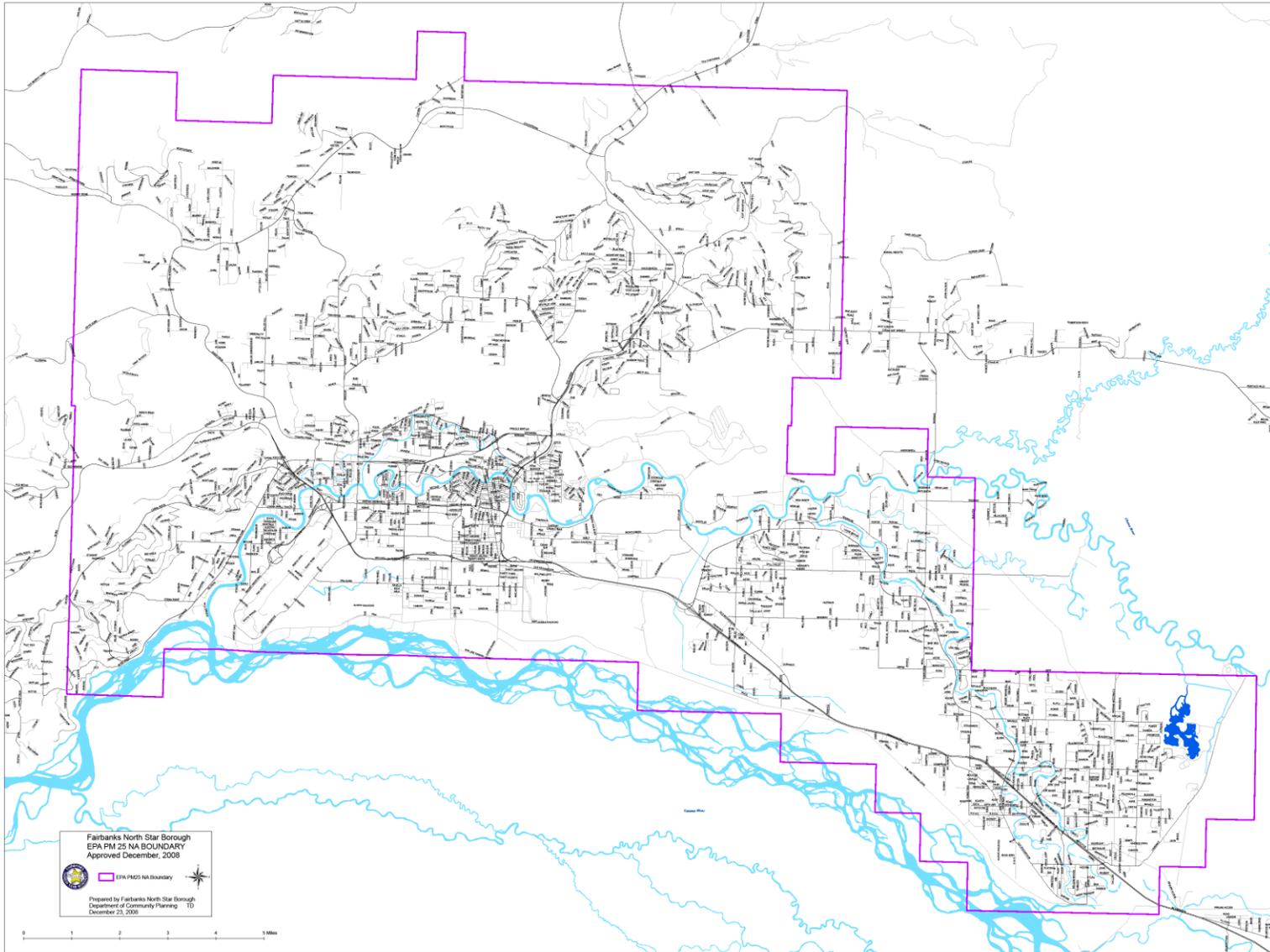
In September 2006 the EPA revised the PM<sub>2.5</sub> 24-hour standard reducing the allowable amount from 65 µg/m<sup>3</sup> to 35 µg/m<sup>3</sup> (see Table 2). This revision took place on the scheduled 5-year review requirement that the EPA follows. The reduction was made after peer reviews of the scientific evidence available and an analysis of the benefit to human health of tightening the PM controls. Evidence was conclusive that tightening PM<sub>2.5</sub> controls would reduce negative health affects and premature death and subsequently the standard was revised. There was no conclusive evidence regarding PM<sub>10</sub> exposures and therefore PM<sub>10</sub> standards were not revised.

Table 2 – Current EPA PM Standards

Criteria	Annual	24-Hour
PM <sub>10</sub>	(Eliminated in 2006)	150 µg/m <sup>3</sup>
PM <sub>2.5</sub>	15 µg/m <sup>3</sup>	35 µg/m <sup>3</sup>

After formalization of the new standard, the EPA required states to submit geographic areas as either being attainment or non-attainment zones for the new 2006 standards utilizing data from 2004-2006. While data from the Borough wasn't extensive, enough information was available for the ADEC to submit Fairbanks and the immediately adjacent communities as a non-attainment area. There was some negotiation between the Borough and the EPA regarding boundary demarcation.. The negotiation resolved amicably and the non-attainment designation by the state of Alaska took place in late 2008 with a reduced boundary satisfactory to both parties.

# EPA approved non-attainment area



The EPA has published declarations by all 50 states in the Federal Register. A required 90-day review period in the Federal Register is now complete and the agreed upon section of the Borough is now legally a non-attainment area.

Table 3 – EPA timelines for implementation of PM<sub>2.5</sub> standards<sup>8</sup>

Milestone	Deadline	Remark
Fairbanks PM <sub>2.5</sub> Designation	December 2008	EPA acceptance of state's designation
Effective Date of Designation	April 2009	90 days after publication in Federal Register
SIPs Due to EPA	April 2012	3 years after effective date of designation
Attainment of PM <sub>2.5</sub> Required	April 2014	5 years after effective date of designation
Possible Extension Period	April 2019	No later than 10 years after effective date of designation

Becoming compliant with the PM<sub>2.5</sub> standards is important for Fairbanks and the Borough for a number of reasons. These reasons include:

- Excessive PM<sub>2.5</sub> concentrations have been linked to increased human mortality and morbidity
- Fairbanks has at times exceeded PM<sub>2.5</sub> standards by as much as 200%
- Air quality has a direct effect on the area's natural and built environments
- If the Borough fails to achieve attainment, EPA could enforce a Federal Implementation Plan (FIP) that may have undesirable or costly methods of achieving attainment
- Several types of federal funding are tied to attaining NAAQS. Loss of federal funding in the Borough would negatively affect the economy
- Non-attainment areas are subject to conformity requirements for large projects such as pipelines, subdivision development, major highway improvements, etc. Conformity requirements may discourage development and add significant costs

Fairbanks and the Borough are clearly responsible to comply with the CAA. The Borough had been compliant with the NAAQS until they were revised by the EPA in 2006. Generally speaking, Fairbanks experiences 25-30 days with measured PM<sub>2.5</sub> concentrations in excess of the revised PM<sub>2.5</sub> standard, all of which occur in the winter. According to an interview held with Dr. James Conner, Air Quality Specialist for the Borough, Fairbanks and adjacent communities have committed to spend several million dollars in the winter of 2008/2009 to provide more extensive and reliable air quality measurements in order to assist in developing a SIP.<sup>9</sup>

Fairbanks is at a crossroads as it evaluates how to come into compliance with NAAQS. The additional data will greatly enhance understanding on the sources of PM<sub>2.5</sub> and other influencing factors. These factors include:

- Effect of the inversion that occurs, particularly at temperatures below -20°F
- Effect of mountainous topography immediately surrounding the Fairbanks area
- Effect of vehicles and other mobile sources
- Effect of power plants, industrial plants, and other stationary sources
- Effect of residential heating systems (oil/wood/coal)
- Effect of nearby communities and any transfer that may be occurring

One result of the Borough's efforts is the recent Cold Climate Housing Research Center (CCHRC) report titled *Reducing PM<sub>2.5</sub> Emissions from Residential Heating Sources in the Fairbanks North Star Borough: Emissions Estimates, Policy Options, and Recommendations*.<sup>10</sup> This timely and valuable report is focused directly on residential heating sources of PM<sub>2.5</sub> in the Borough. The Borough continues to evaluate the potential of other contributors in the local area through other means. This analysis and report will utilize the CCHRC report in the identification of opportunities for improving air quality in the Borough.

### **Worth of Human Health**

While no one can put a price tag on life or what one would be willing to pay for an additional year of life or quality of life, government entities must assign a value on a statistical life to make rational decisions about regulations.

Public organizations, like local governments, evaluate costs based on the same investment decisions as private businesses, yet their economic analysis is complicated by several aspects: First, the public entity must consider the overall purpose of the investment and the effects of politics and stakeholders of the project, as well as the project financing sources, and expected project duration

The amount of damage caused by even one day of exposure to harmful levels of PM<sub>2.5</sub> is hard to calculate. In a study prepared by Francesca Dominici of the Department of Biostatistics Johns Hopkins Bloomberg School of Public Health, the goal was to determine the short-term effects. Using hospital admission data and PM<sub>2.5</sub> readings from 400 counties throughout the

lower 48, the data revealed that when there was an increase of just 10 units in PM<sub>2.5</sub> hospital admissions increased by 1 % for chronic obstructive pulmonary disease, and by 1.7% for heart failure.

There are many ways to define the price of human health. Two common techniques are the Benefit-Cost (BC, also called Cost-Benefit) Analysis, which uses the BC ratio, and the Cost-Effectiveness (CE) Analysis, which uses the CE ratio. According to the EPA National Center for Environmental Economics website, the EPA uses the BC analysis and bases its numbers off of studies that focused on the difference in pay between riskier and less risky jobs.<sup>11 12</sup>

$$\text{BC ratio} = \frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}}$$

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Cost-Effectiveness Analysis focuses more on the difference between two alternatives.

$$\text{CE ratio} = \frac{\text{cost}_{\text{new strategy}} - \text{cost}_{\text{current practice}}}{\text{effect}_{\text{new strategy}} - \text{effect}_{\text{current practice}}}$$
 14

Both analyses' ratios have their strengths and weaknesses. The BC ratio can be used on a single alternative, while the CE ratio must have two alternatives. BC analysis is usually used for the larger picture, the total benefit to society, while CE's are most often used for finding out how much worth a change adds.<sup>15</sup>

In order to make a decision based on the merit of the project, the local government assesses the BC ratio which measures the equivalent worth of the benefits or investment in a project to the equivalent worth of costs. If the BC ratio is greater than 1.0, the project under evaluation is accepted".<sup>16</sup> Uncertainty in quantifying costs and the long life of the project lessens the reliability of the BC ratio.

The EPA estimates that the BC for the PM regulation cost about \$2,381,000. Though they did not base their changes to the PM regulation on the BC, the EPA believes that the BCs done for the CAA (a total of six) increased the total benefits of the act by more than \$10 billion.<sup>17</sup>

The EPA has the current value of a human life set to \$6.9 million.<sup>18</sup> The EPA did several comparisons using annual mortality risks to compare different levels of allowable PM and then averaged two of the studies amounts. The two studies came up with 0.36 and \$2.80

respectively for a reduced annual mortality risk by one in a million.<sup>19 20</sup> In comparison, the Federal Department of Transportation has set the value of a human life at \$5.8 million and one study for the National Institute of Health put the cost of one year of life at \$150,000, which was based on the “willingness-to-pay” paradigm.<sup>21</sup>

However, these BCs were not used to decide what level of PM the updated law would allow, but instead to explain and support the decision they made. Under the CAA, regulation has been based on impacts to human health and does not take the monetary impacts into consideration.<sup>22</sup>

Public decision makers must choose between alternatives that affect the livelihoods of constituents on one hand, and their health and welfare on the other. Compromise must be reached and the BC analysis can help justify policy decisions. From the viewpoint of the local government, the best outcome is not as obvious as from an industry outlook. “The proper approach is to take a viewpoint at least as broad as those who pay the costs and those who receive the benefits.”<sup>23</sup> In this situation, improving air quality in the non-attainment area will benefit individuals living throughout the Borough, individuals that travel to Fairbanks for medical and business meetings, and winter tourists, to name just a few of the stakeholders.

### **Stakeholder Analysis**

There are numerous stakeholders who have an interest in Borough air quality issues. “A stakeholder in a project may be defined as any group or individual who can affect or who is affected by the achievement of the project objectives.”<sup>24</sup> Stakeholders include the regulatory agencies and their representatives, neighboring municipalities, individuals and businesses who will be asked to modify their behavior, special interest groups, and members of the community at large. Stakeholder analysis will give insight into the support, or adverse reactions, one might expect from a change in policy.

### **Stakeholder Procedure**

There are several steps necessary in order to evaluate the impact that the stakeholders may have on a project. These steps are:<sup>25</sup>

1. Identify appropriate stakeholders
2. Measure the stakeholder’s interest
3. Specify the nature of the stakeholder’s interest
4. Predict what each stakeholder’s future behavior will be to satisfy interests
5. Evaluate the impact of the stakeholder’s behavior on the project team’s decisions.

## Stakeholders Identification

Thirty-one primary stakeholders were identified with regard to the two opportunities being evaluated in this report: wood stoves and diesel emissions. These individuals or groups will be directly affected by the suggested regulation changes and enforcement requirements.

Stakeholder Tables 1, 2 and 3, identify the stakeholders' relationship to the system. The first step is to recognize which factors would be a benefit if PM<sub>2.5</sub> were reduced and which factors would be a disbenefit. These "categories" are listed in the column headings. Benefit categories include: continued federal funding; reduced EPA oversight; better health and environment; and continued growth in the community. Disbenefit categories include: interference from more regulation, increased expenses. Stakeholders were also divided into the major groupings shown below.

- Project Financier: Agencies that will fund project or supply necessary resources (29%)
- Contractor: Stakeholders who will benefit monetarily from the outcome of the regulations (26%)
- Decision Makers: Authorities with responsibility or ability to execute aspects of the project (16%)
- Interest Groups: Other organizations or groups of individuals that have a vested interest in the success or failure of the project (16%)
- Legal: Agencies that have legal responsibility or regulatory authority regarding execution of this project (26%)
- Technology: Those who have a technological interest or claim (45%)

According to this evaluation, FNSB, EPA, ADEC, AK Department of Transportation (AK DOT), FNSB Inspection & Maintenance (I/M) and Air Pollution Control Commission, the City of Fairbanks, and the City of North Pole will play regulatory roles in the establishment of any requirements to control wood burning devices or to limit vehicle emissions, which is about 26% of the total stakeholders. The majority of the stakeholders will benefit, 16% will have continued funding, 26% will have reduced EPA oversight, 100% of the stakeholders will benefit by better health, and environment and it is estimated that 86% of these stockholders will benefit from the continued growth that comes to the community as long as air quality stays good.

The percent of those who benefit greatly outweigh the disbenefit categories, but the few who are negatively affected are usually much more vocal. About 46% will be restricted by the regulations and 16% will pay more due to the changes.

Table 1 Identification of Stakeholders

STAKE-HOLDERS	SYSTEM	BENEFITS of coming into Attainment Who benefits from ...				DISBENEFITS of new FNSB restrictions		PROJECT FINANCIERS	CON-TRACTORS	DECISION MAKERS	INTEREST GROUPS AND ORGS.	LEGAL OR REG. INTEREST	TECH-NOLOGY INTEREST	TOTAL TIMES IDENTIFIED
		Who is in the System?	Cont. Federal Funding	Reduced EPA Oversight	Better Health & Enviro.	Cont'd Growth	Increased restrictions	Increased cost	Who will pay for the project?	Who will make money from regulations?	Who holds decision authority	Other misc. groups	Who has legal resp. to this project?	
FNSB	X	X	X	X	X	X		X		X		X		10
AK DOT	X	X	X	X	X	X		X		X		X		10
FNSB IM and Air Pollution Control Commission	X	X	X	X		X		X	X	X		X	X	10
ADEC	X		X	X	X	X		X		X		X	X	8
City of Fairbanks	X	X	X	X	X			X				X		7
EPA	X		X	X	X			X		X		X	X	6
City of North Pole		X	X	X	X			X				X		6
MACS	X			X	X	X		X	X					6
Power Plant Operators			X	X	X	X							X	5
Unleaded Coal			X	X	X	X							X	5
Fairbanks Int. Airport				X	X	X					X		X	5
Semi-truck Drivers				X	X	X	X						X	5
Diesel Fuel Producers/Suppliers				X	X	X			X				X	5
Compliant Wood Stove Suppliers				X	X				X				X	4
Home Contractors				X	X				X				X	4
Real Estate Agents				X	X				X		X			4
School Bus Companies				X	X	X	X							4
Diesel Mechanics				X	X				X				X	4
Eielson AFB			X	X	X			X						3
Pt. Wainwright			X	X	X			X						3
Home Owners: Non-Compliant Solid Fuel				X	X	X	X							3
Tourism Industry/Tourists				X	X						X			3
University Students				X	X						X			3
Healthcare Industry				X	X						X			3
Fuel Suppliers Wood				X	X	X		X						3
School Districts				X	X	X	X							3
Northern Alaska Environmental Center				X	X						X			2
Alaska Railroad				X	X	X								
Home Owners: Compliant Solid Fuel				X									X	
Home Owners: Oil				X										
Non-Compliant Wood Stove Suppliers				X		X	X							
% of Stakeholders Identified	23%	16%	35%	100%	68%	43%	16%	29%	23%	16%	16%	26%	45%	

ADEC - Alaska Department of Environmental Conservation	FNSB - Fairbanks North Star Borough	Northern Alaska Environmental Center
AK DOT - Alaska Department of Transportation	FNSB IM and Air Pollution Control Commission	Diesel Fuel Operations
Alaska Railroad	FNSB Metropolitan Area Computer System (MACS)	Real Estate Agents
City of Fairbanks	Pt. Wainwright	School Bus Companies
City of North Pole	Fuel Suppliers Wood	School Districts
Compliant Wood Stove Suppliers	Healthcare Industry	Semi-Truck Drivers
Diesel Fuel Producers/Suppliers	Home Contractors	Tourism Industry/Tourists
Diesel Mechanics	Home Owners: Non-Compliant Solid Fuel	University Students
Eielson AFB	Home Owners: Oil	Unleaded Coal
EPA - Environmental Protection Agency	Home Owners: Compliant Solid Fuel	
Fairbanks International Airport	Non-Compliant Wood Stove Suppliers	

The numbers in the last column of Stakeholder Table 1 indicate the level of vesting each stakeholder has in the overall project of reducing PM<sub>2.5</sub>. The top three vested agencies are FNSB, AKDOT and the FNSB Air Quality Division. Each of these agencies scored results in ten of the 13 categories. ADEC scored in eight of the 13, the City of Fairbanks and the City of North Pole scored seven. This table assumes equal merit of the questions and does not take into account that the categories evaluated could be weighted based on the relative importance of each category.

The next step is to specify the nature of each stakeholder's interest. Stakeholder Table 2 summarizes the function of each stakeholder group as it relates to this project and lists its affiliation. The chart also includes a brief description of how the enactment of recommendations would affect the stakeholder. The percentage of stakeholders by type in the analysis is: Government: 27%, Private: 19%, Individuals 27%, Special Interest Group: 15%, Community: 15%.

Stakeholder Table 3 evaluates the relationship of the stakeholder to the environment of the project. A stakeholder is politically, economically or socially vested in the project and may fall within more than one category. It is beneficial to be aware of the alliances that may occur between stakeholders. Evaluation of the stakeholders is a critical element in preparing communication with the public. Presentations can be tailored to the audience based on what specific aspect of the project that will be of most concern to them and include favorable aspects of the project and mitigate the negative aspects.

It is necessary to determine how the stakeholders are likely to react to project decisions and what influence their reaction will carry, and how they might interact with each other. The project manager can utilize this information to convey the project goals with regard to the important issues of each stakeholder group. It is important to address contentious issues at the onset of the meeting, acknowledging that in some cases certain stakeholders will not favor the decisions. It is the project manager's goal to show how the overall benefit outweighs the negative results, even though some have to compromise to come into compliance with the EPA standard.

**Table 2 Stakeholders' Function**

<b>Stakeholders</b>	<b>Function</b>	<b>Classification</b>
<b>ADEC</b>	Alaska Department of Environmental Conservation - State governmental agency - represents the State of Alaska to the EPA.	<b>G</b>
<b>AK DOT</b>	Alaska Department of Transportation - May lose funding in the Fairbanks North Star Borough if the Borough does not come into compliance with the EPA standards. Has regulatory responsibilities for IM testing.	<b>G</b>
<b>Alaska Railroad</b>	Transports coal throughout the state and also burns coal/ULSD in the train engines. Suggested regulations will only have a minor effect of their market for selling or using coal, but reduced tourism would have a great impact.	<b>C</b>
<b>City of Fairbanks</b>	Local municipality that is at the heart of the Borough. This is the most concentrated grouping of individuals.	<b>G</b>
<b>City of North Pole</b>	Local municipality that is 14 miles from Fairbanks. This area may be subject to the regulations set forth for this non-attainment area.	<b>G</b>
<b>Compliant Wood Stove</b>	Owners of businesses selling wood stoves or ceramic stoves that are approved by EPA and meet the PM <sub>2.5</sub> standards.	<b>I</b>
<b>Diesel Fuel Producers/</b>	Will be required to have the ultra low sulfur diesel fuel	<b>C</b>
<b>Diesel Mechanics</b>	Semi-trucks and school busses will need to be retrofitted, thus causing additional revenue for the mechanics,	<b>C</b>
<b>Eielson AFB</b>	Air Force Base 25 miles south of Fairbanks. Not part of the non-attainment area.	<b>SI</b>
<b>EPA</b>	Federal Governmental agency that regulates and enforces the Clean Air Act. The Clean Air Act requires EPA to set National Ambient Air Quality Standards for pollutants considered harmful to public health and the environment. The Clean Air Act establishes two types of national air quality standards.	<b>G</b>
<b>Fairbanks Int. Airport</b>	Commercial runway in Fairbanks that handles cargo and passenger aircraft.	<b>SI</b>
<b>FNSB</b>	Fairbanks North Star Borough is the local governmental entity that has been charged with non-compliance to the EPA standard for Clean Air Quality. Including both the cities of Fairbanks and North Pole, it encompasses 7,361 square miles. FNSB need to bring prepare SIP plan by 2012 and bring borough into attainment by 2014.	<b>G</b>
<b>FNSB IM and Air Pollution Control Commission</b>	Established by ordinance under Chapter 2.48 to develop comprehensive plans for the prevention, abatement, and control of air pollution in the borough, act as an appeals board to decisions of the IM (Inspection and Maintenance) Program, and generally act as an advisory body to the IM Program.	<b>G</b>
<b>Ft. Wainwright</b>	Military Army Post within the non-attainment area.	<b>SI</b>
<b>Fuel Suppliers Wood</b>	Those individuals that make their living from cutting and supplying wood, and the coal supplying outlets that act as an intermediary between Usabeli and the home owner end user.	<b>I</b>
<b>Healthcare Industry</b>	Medical institutions, doctors and insurance providers are included in this group.	<b>SI</b>
<b>Home Contractors</b>	Building contractors that will benefit from increased demand to retrofit stoves or to change-out stoves at time of sale of home.	<b>C</b>
<b>Home Owners: Non-Compliant Solid Fuel</b>	Owners of wood stoves or wood/coal burning hydronic heating systems that are not approved by EPA and do not meet the PM <sub>2.5</sub> standards.	<b>I</b>
<b>Home Owners: Oil</b>	Home Owners that heat with fuel oil.	<b>I</b>
<b>Home Owners: Compliant Solid Fuel</b>	Home Owners of wood stoves or ceramic stoves that are approved by EPA and meet the PM <sub>2.5</sub> standards.	<b>I</b>
<b>MACS</b>	Transit system that services the downtown and outlying areas of Fairbanks and the neighboring communities of North Pole.	<b>C</b>
<b>Non-Compliant Wood Stove Suppliers</b>	Owners of businesses selling wood burning hydronic heating systems and other non-compliant heating sources.	<b>I</b>
<b>Northern Alaska Environmental Center</b>	Located in Fairbanks, this local agency promotes conservation of the environment in Interior and Arctic Alaska through advocacy, education, and sustainable resources.	<b>SI</b>
<b>Power Plant Operators</b>	Companies that power their businesses, or create electrical energy for sale, from the burning of coal in a large scale operation (size) with the need for smoke stakes in accordance with EPA permit.	<b>C</b>
<b>Real Estate Agents</b>	Real estate agents will be responsible for insuring that any non-compliant EPA stoves, or other wood burning device is changed out to an approved model before the close of the transaction.	<b>SI</b>
<b>School Bus Companies</b>	Like semi-trucks, can also retrofit school buses	<b>C</b>
<b>School Districts</b>	The Fairbanks North Star School District and several other schools contract for school bus services. The cost to these schools will increase as a result of the change.	<b>G</b>
<b>Semi-truck Drivers</b>	Operators of heavy diesel vehicles that support the petroleum, construction, and logistic supply functions in the local area.	<b>I</b>
<b>Tourism Industry/Tourists</b>	Fairbanks has a year-round appeal to tourists who want to experience the extremes that Alaska has to offer. Special winter activities include the International Ice Carving Championships, sled dog races and northern light viewing.	<b>SI</b>
<b>University Students</b>	The University of Alaska attracts approximately 33,000 students annually from throughout Alaska, other states, and 52 foreign countries. In order to continue to attract students the environment and health continues must remain good.	<b>SI</b>
<b>Usibeli Coal</b>	The Usibeli coal company has been in operation from 1946. It is the only operational coal mine in Alaska. The coal mine produces subbituminous coal, the low end quality coal material that burns with more pollution.	<b>C</b>
<b>LEGEND</b>	G - Government C - Commercial I - Individual SI - Special Interest	

Table 3 Stakeholders' Environment

Stakeholder	Political Internal	Economic Operating	Social General
ADEC	Support for FNSB plan and interfacing with EPA.	Help fund projects with FNSB.	Responsible to the state citizens.
AK DOT	Enforces I/M guidelines and other new diesel regulatory measures.	Funds the programs.	Reducing emissions on your vehicle.
Alaska Railroad	RR must comply with regulations	May need costly modifications to comply	
City of Fairbanks	Following guidelines of FNSB	May establish fine or incentive program.	Responsibility to members of community.
City of North Pole	Establishes the guidelines for its separate community	May establish fine or incentive program.	Responsibility to members of community.
Compliant Wood Suppliers		Will have the correct stove to sell to the public	
Diesel Fuel Producers/Suppliers		May have additional costs, but should be able to recover by increasing cost of fuel to truck drivers	
Diesel Mechanics		Should be supportive since they will gain work from the conversion requirement.	
Eielson AFB	Enforces guidelines		
EPA	Final approval of FNSB and ADEC plan and responsibility to enforce.	May impose fines or stricter testing regulations.	Fulfilling Federal laws to ensure the health of the citizens.
Fairbanks Int. Airport		Will suffer if tourism decreases or jet fuel costs rise too high due to new restrictions.	
FNSB	Development of SIP plan to come into compliance.	Enforces the laws and finances plan.	Responsible to protect the people of community.
FNSB I/M and Air Pollution Control Commission	Advises the FNSB council on the guidelines for the IM emissions and monitors air pollution	This boards ideas often lead to costly tests and possible retrofits.	
Ft. Wainwright	Enforces guidelines		
Fuel Suppliers Wood		Fewer people will be in need of wood	
Healthcare Industry		More people will be healthier	
Home Contractors		Will earn funds when homeowners need to replace stoves	
Home Owners: Non-Compliant Solid Fuel		Will have to replace, retrofit or remove non-compliant stoves.	
Home Owners: Oil			Oil burning furnaces are exempt from regulation for PM <sub>2.5</sub> .
Home Owners: Compliant Solid Fuel			Are already complying with best standards
MACS	Transit system for entire FNSB	Brings in enough revenue to pay for it's operating cost	
Non-Compliant Wood Stove Suppliers		Will no longer be able to sell their product.	
Northern Alaska Environmental Center			In general supportive of restrictions to reduce air pollution, may feel more needs to be done, or quicker
Power Plant Operators			Socially responsible for them to try and reduce emissions of PM <sub>2.5</sub>
Real Estate Agents		They are charged with overseeing conversion at point of sale	
School Bus Companies		Requirement to retrofit buses with emissions control and/or use low sulfur diesel fuel will be costly.	May drive up cost of contract with school districts for bussing services.
School Districts		Though they would like to have cleaner air, the requirements to retrofit buses will cause the cost of the contracts with independent bus companies to increase.	
Semi-truck Drivers		Requirement to retrofit truck with emissions control and/or use low sulfur diesel fuel will be costly.	May drive up costs of all goods transported in our area.
Tourism Industry/Tourists		If tourism goes down, many loose jobs and other tax based funds will decrease.	
University Students		UAF enrollment will decrease if Fairbanks viewed as bad air city.	
Usibeli Coal		Coal supplies for home use may reduce or increase revenues.	

## **Opportunities Rationale**

This report focuses on opportunities to reduce  $PM_{2.5}$  by regulating residential wood burning stoves and diesel emissions. These are the two biggest contributors to  $PM_{2.5}$  counts during cold inversions. Both of these options focus on areas where actual improvements can be made, monitored, and measured for impact on the air quality in Fairbanks. An additional benefit to reducing the stove and diesel engine sources of  $PM_{2.5}$  emissions is that there are numerous opportunities for federal funding to assist in the implementation of the proposed plans. These two prospective opportunities for improvement allow for immediate, focused realization of a reduction in the  $PM_{2.5}$  emissions concentration in areas that have the highest particulate counts. A more gradual implementation across the Borough as a whole can also be considered as long as funding and support is available.

## **Rationale for Excluded Sources**

There are other potentially high sources of  $PM_{2.5}$  content in the Fairbanks area that could be targeted for reduction of emissions, but the necessary investment would not be justified based on the amount of  $PM_{2.5}$  removed and the timing of those emissions. For example: large producers, like local power plants, seem like they would be big contributors, but they already have strict EPA and federal guidelines on the waste they produce. Additionally, the majority of the waste output from the power plants is in the form of gas elements, such as  $NO_x$  and  $SO_x$ . Only 460 tons/year (TPY) of  $PM_{10}$  particulate matter is produced by local power plants out of a total of 27,299 TPY in the Fairbanks monitoring area<sup>26</sup> this equates to only 1.7% of the total  $PM_{10}$  output. Assuming a similar level of  $PM_{2.5}$  generation, it would not seem cost effective to enforce a regulation requiring retrofit of power plant equipment.

Wildfire is another high contributor to poor air quality, but this only occurs in the summer and does not impact the winter  $PM_{2.5}$  level that contribute to the Boroughs non-attainment status.

Another area that was briefly evaluated was 2-stroke snowmobile  $PM_{2.5}$  emissions and what could be done with these to improve the output from the engines. At only a third the total TPY that are produced by diesel engines, the 2-stroke recreational snowmobiles produced more  $PM_{2.5}$  output than all heavy and light gasoline vehicles (11 TPY). Studies have been done using additives to the gasoline and oil mixture without much success.<sup>27</sup> Some reduced emissions output results were identified with specially designed clean 2-stroke engines using both atomizing carburetors and catalytic converters, although this is an extremely pricey modification

to retrofit on a snowmobile and these have not been widely implemented in new models being sold.<sup>28</sup> Additional consideration that most people do not tend to ride or use recreational snowmobiles during extremely cold weather conditions indicated this line of research was not worth pursuing as a possible solution for 24-hour PM<sub>2.5</sub> emission levels when an inversion occurs.

## **Opportunity 1 – Residential Wood Burning Stoves**

### **Emissions of Stoves**

Fireplaces, wood stoves, and other home heating devices are nice to have, particularly in the wintertime. This is especially true in the FNSB. However, these devices use combustion in various ways to heat our homes and combustion results in smoke. Smoke contains harmful chemical substances such as CO, volatile organic compounds (VOCs), NO<sub>x</sub>, dioxin, and inhalable PM. Some of the VOCs are toxic and potentially cancer causing. Depending upon the amount of sulfur in certain types of fuel, SO<sub>x</sub> can also result. One of the biggest threats to human health from smoke comes from PM. Some may think that wood is a safer fuel but even wood smoke PM is comprised of wood tars, gases, soot, and ashes. Despite current EPA regulations regarding emissions allowances, smoke exposure still occurs, both indoors and outdoors, and it is a real threat to human health. For these reasons, the EPA issued a regulation in 1988 specifying standards of performance for all wood stoves built after 1988.<sup>29</sup>

Exposure to combustion pollutants can seriously affect a person's health. Typical symptoms from combustion pollutants include – headaches, dizziness, sleepiness, coughing, and watery eyes. Medical problems resulting from combustion pollutants can include colds, flus, and allergies. CO poisoning is a real and serious medical condition that is an exposure risk to combustion pollutants.<sup>30</sup>

The effect of stove emissions on communities has been well known for a number of years and has resulted in many regulatory efforts to control the types of stoves, when and how the stoves are used, and where they can and can't be installed. This issue is not new to the Borough or to the United States. The negative effects of stove emissions have been studied in the Borough for more than twenty years and even though recent changes to PM<sub>2.5</sub> standards have drawn more attention to the issue, the Borough has been aware of and monitoring the situation for some length of time.

## Descriptions of Various Stoves

There are a variety of stoves in operation throughout the United States and the Borough. These include fire places, non-certified (pre-1988) wood stoves, EPA certified wood stoves, outdoor hydronic heating wood stoves, pellet stoves, coal stoves, oil fired furnaces, and natural gas furnaces. Descriptions of the different types of stoves are listed below:

**Fireplace:** An architectural structure to contain a fire for heating and sometimes cooking. The fire is contained in a firebox or fire pit. A flue or chimney system is used to direct flue gas and particulate exhaust to the outdoors.

**Non-Certified Wood Stove:** Heating appliance capable of burning wood fuel or wood-derived biomass fuel. Generally consists of a solid metal closed fire chamber, a grate, and an adjustable air control. The appliance is connected to a stove pipe and chimney system. This particular type was built prior to 1988 when the EPA started regulation of wood stoves.

**EPA Certified Wood Stove:** Heating appliance built after 1988 in conformance with EPA performance standards. This appliance is configured to manage combustion in ways that reduce PM emissions from the stove. Some stoves utilize a catalytic converter to more thoroughly burn gasses generated during combustion. There are numerous types of EPA certified wood stoves including catalytic, wood pellet, and even wood-fired hydronic heaters (see below).

**Wood-Fired Hydronic Heater:** Stand-alone stove that operates outside the home also known as outdoor wood-fired boiler. Some devices can burn either coal or wood and use a fire box and water jacket system to distribute hot water or glycol to a home hydronic system. Unit normally comes in self-contained package or shelter that includes short stove pipe and/or chimney.

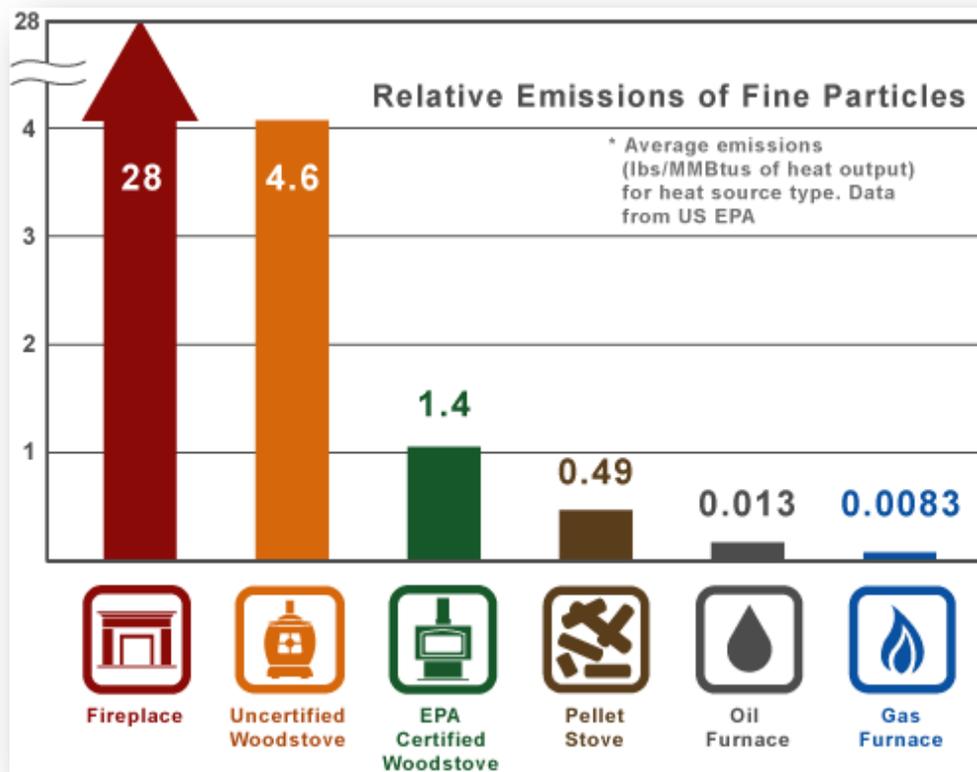
**Pellet Stoves:** Interior wood burning stove that utilizes crushed wood known as pellets or biomass as the fuel source for combustion.

**Coal Stoves:** Interior burning stove that utilizes coal as the primary fuel source and vents using a stove pipe or chimney for exhaust.

**Oil Fired Furnaces:** Residential and commercial direct-fired heating source that utilizes oil as the main fuel. Generally uses a firebox as a combustion chamber and a heat exchanger to transfer heat to either air or water

**Natural Gas Fired Furnaces:** Residential and commercial direct-fired heating source that utilizes natural gas as the main fuel. Generally uses a firebox as a combustion chamber and a heat exchanger to transfer heat to either air or water.

The different types of stoves generally have different emissions rates that are affected by the usage or operation methods. An EPA derived table shown below indicates average emission



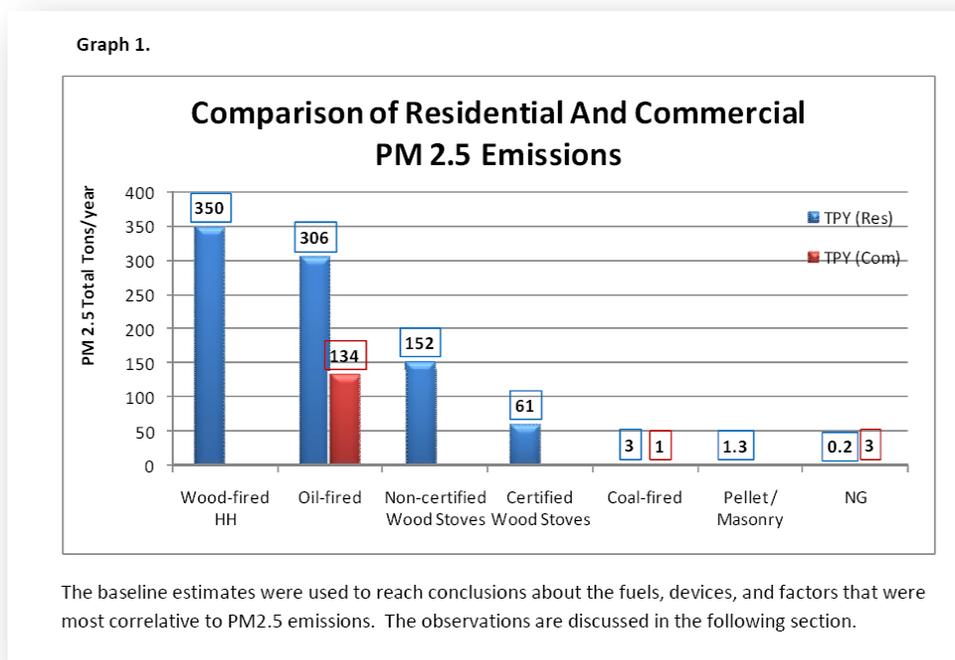
rates for various types of stoves.

The EPA reports that a clean burning, EPA-certified wood stove emits approximately 70% less particle pollution, on average, than older, less-efficient stoves or fire place inserts. A comparison of the fine particle emission rates between the older and newer stoves shows that old, non-certified stoves emit 30-50 grams per hour of fine particles (<2.5 microns) per hour

whereas newer, EPA certified wood stoves emit 2-7 grams per hour. Overall efficiencies of the stoves are reported at 40-60% and 60-80% respectively.

The February 2009 CCHRC report provides a significant amount of information that addresses the Borough's ability to come into compliance with the current PM<sub>2.5</sub> standards. The report utilized emission modeling to estimate that residential sources are the 2<sup>nd</sup> largest contributor of PM<sub>2.5</sub> emissions in the Borough with a total of 874 TPY.<sup>31</sup>

The CCHRC report also indicates that wood fired stoves account for three of the top four residential contributors to PM<sub>2.5</sub> emissions.<sup>32</sup> Wood-fired hydronic heaters are the largest contributor at an estimated 350 TPY, with oil fired furnaces at 306 TPY, non-certified wood stoves at 152 TPY, and certified wood stoves at 61 TPY. Residential emissions account for 27% of estimated emissions in the Borough.



Source: CCHRC report<sup>33</sup>

Of the estimated 874 TPY estimated emission from residential sources, wood fired stoves account for 65% of the emissions. The modeling accomplished by CCHRC allowed them to make several distinct observations on sources in the Borough:

1. Residential heating is a significant source of PM<sub>2.5</sub> emissions

2. Wood combustion is the most significant source of PM<sub>2.5</sub> emissions in the residential heating category
3. Wood-fired hydronic heaters emit more annual tons of PM<sub>2.5</sub> than any other residential heating category and are on the scale of point sources

Oil fired furnaces are a significant source of PM<sub>2.5</sub> emissions in the Borough. Due to energy losses caused by the process that removes sulfur and the additional cost of manufacturing, heating oil is not being discussed as an option in this report.<sup>34</sup> Modeling accomplished in the CCHRC report also indicates that coal fired stoves are well below 1% of the estimated TPY of PM<sub>2.5</sub> contribution. Even though residential coal fired stoves can create serious emissions problems at a localized level, they are not a major contributor to the overall Borough non-attainment issue.

It is evident from the CCHRC modeling data that residential wood stoves are the largest residential contributor and their emissions are almost exclusively PM<sub>2.5</sub> emissions. Therefore, evaluations of how to reduce oil fired furnace, coal fired stove, or natural gas fired furnace emissions were not detailed further in this report. Rather, focus will be on ways to reduce the amount of PM<sub>2.5</sub> emissions from two main categories of wood stoves. Category 1, non-EPA certified wood stoves will represent those fireplaces, wood-fired hydronic heaters, and wood stoves that do not meet EPA performance criteria. Category 2, EPA certified wood stoves will represent those fireplaces (typically with inserts), wood-fired hydronic heaters, and wood stoves that do meet EPA performance criteria. The EPA maintains a list of over 700 approved wood burning devices that meet their performance criteria for emissions (7.5 grams/hour for non-catalytic stoves and 4.1 grams/hour for catalytic stoves). Included on this list are fifteen wood-fired hydronic heaters. Pellet stoves are not prevalent enough in the Borough to be evaluated and pellet stoves that do exist have relative emissions of approximately one third compared to EPA certified wood stoves.

## **Suggested Programs**

### Public Awareness and Voluntary Burn Ban

Educating the public on the dangers of PM<sub>2.5</sub> and the way to limit exposure is at the heart of compliance with woodstove regulations. The individuals that will be asked to limit use of the stove on burn ban days, or asked to change to an EPA certified stove, need to understand that there are benefits to the program. The campaign about the dangers of PM<sub>2.5</sub> needs to inform

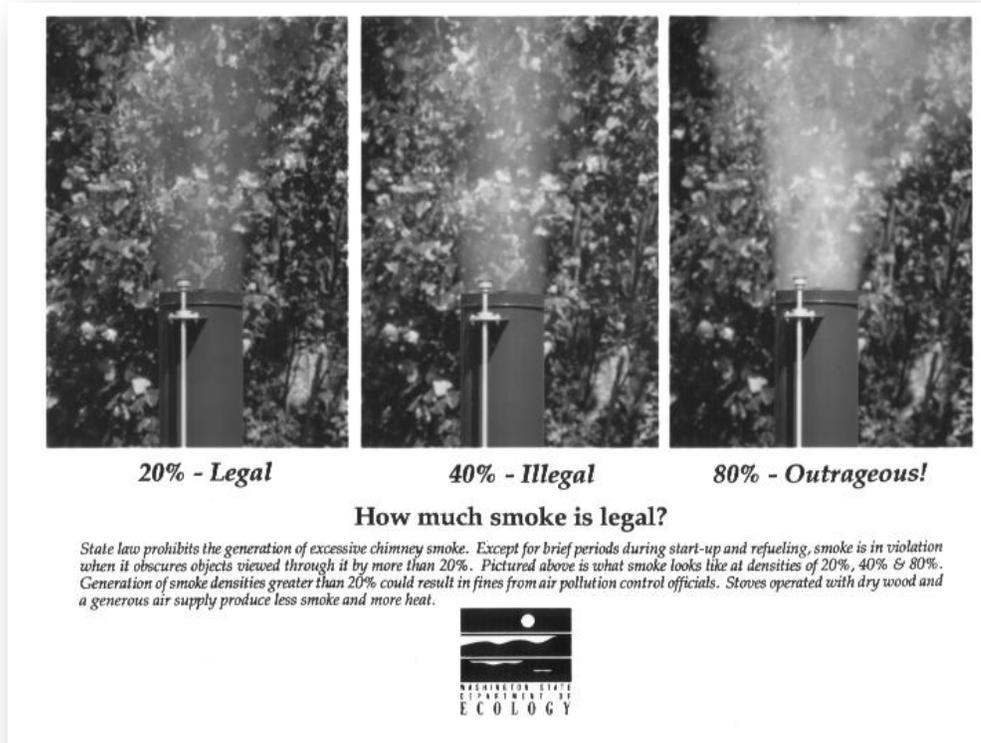
the public of the health risks, cost savings associated with using a more efficient stove and burning dry wood, and how much improvement is associated with each proposed change. The focus of the education program should be to set the stage for acceptance of the other betterment opportunities. As these new regulations are established, education efforts need to continue to teach the residents about the laws and explain the change-out programs. Integral to the education program is strong website with all the local information and links to other agencies' information.

Stemming from the increased public awareness is the hope that households will voluntarily comply with burn restrictions. If an inversion is expected due to extreme cold or stagnant air, wood burners would be requested to heat with another source. Generally the inversion occurs when the temperatures in the Interior are the coldest, -30°F and colder, and the residents are often dependent on the extra heat produced by a woodstove. There will be exemptions, as some people only heat with wood, and compliance may be marginal, therefore this measure is really only the first step in restricting wood stove use.

If the voluntary measures do not have the expected results, the next step would be an Ordinance requiring mandatory compliance for non-burn days. The Puget Sound Air Quality Agency has a successful program based on this premise. They have enacted a law requiring compliance with burn bans that is enforced with a \$1,000 fine. There are two stages of alerts; stage one is enacted on moderately bad days and all fireplaces and uncertified woodstoves are banned unless it is the residence's only source of heat. In stage two, certified woodstoves and pellet stoves become included in ban.<sup>35</sup>

In Alaska, municipalities are given the right to enact regulations on air pollution control under Alaska Statute AS§29.35 and air quality control under AS§46.03. Currently there is a chapter in the Borough Code of General Ordinances (Code) addressing Air Pollution which regulates burning material in the open and has a \$300 fine for each violation. Modification of this chapter of the Borough Code to include a violation for emitting more than a certain percentage of emissions from a wood stove will be much easier than enforcing the regulation and determining the amount of emissions just by sight.

According to the Puget Sound website, the Department of Ecology defines excess chimney smoke as 20% opacity or more.



According to the CHCRC report the Borough may want to adopt a "nuisance emission ordinance" which addresses the qualitative emission of the application, not the specific type of stove. A case could be made that the nuisance created by the harmful wood smoke has such a detrimental effect that the devices should be regulated by the Borough air quality division as outlined in Chapter 8 of the Borough Code, Carbon Monoxide Emergency Episode Prevention Plan. This would give a neighbor the means to report someone who is in violation.

### Change-out Programs

Since 1988 EPA has certified certain woodstoves and fireplace inserts meet their standards for clean burning and efficiency. In a drive to get citizens to replace the older polluting woodstove with a new EPA stove, EPA has offered help with education and funding for various change-out programs. In some cases the change-out program has even included an incentive to change to oil-fired boiler.

Benefits of changing out inefficient woodstoves with new, cleaner burning appliances:

- Reduces fine particle and toxic pollution by 70%;
- Helps states get SIP emission reduction credits
- Improves indoor air quality, older stoves are often poorly sealed and ventilated
- Improves energy efficiency by 50%
- Changing out 20 woodstoves will result in reducing ~1 ton of fine particles

The EPA spearheaded a national change-out program between 2005 and 2007 sponsored in large part by private industry such as the Hearth, Patio and Barbeque Association, American Lung Association, local businesses and state and local governments.<sup>36</sup> Funding opportunities continue to be available through EPA Supplemental Environmental Program, Housing and Urban Development, United State of Department of Agriculture, Bureau of Indian Affairs, as well as federal legislative acts that are being developed, such as the 2008 federal tax credit. Many private manufacturers of stoves also have rebate programs. Communities with the most successful programs have also included educational workshop to show the public the difference in performance of EPA and non-EPA stoves by burning these models side-by-side. Workshops can also teach other clean burning techniques and safety issues.

**Voluntary Replacement Tax Credit:** Many communities give a one-time tax credit to individuals that voluntarily purchase a new EPA certified stove or fireplace insert and turn in the old stove to be destroyed. It is important to stress that the non-compliant stove be removed from service permanently. In order to fund this program, it would be important for the Borough to limit the number of tax credits that are available each year. The Borough may choose to only offer the rebate during the time frame when the SIP is being implemented. It may be necessary to begin to issue permits for woodstove and fireplace installation if this rebate is to be utilized.

The estimated number of non-certified stoves is 5,000 and 1,500 outdoor wood burning hydronic heaters. Even if all 6,500 devices were changed out and each given a \$500 tax credit, the total cost would be minimal compared to the benefit. It can be assumed that this cost would be spread over the five-year period, since the CAA allows that long for the SIP plan to bring the Borough into compliance. In addition, the Borough may choose to limit the number of change-out tax incentives they can issue each year. For example, the budget may allow only 1,000 change-out benefits per year. In addition, available funds from other state and federal agencies could be used to match the Borough funded program.

Two bills are currently being considered that would allow the Borough to give residents a property tax credit based on the percentage of the cost of the improvement, if they take steps to improve air quality by trading up for a better home heating system.<sup>37</sup> “Each municipality will establish the eligibility, conditions and other criteria for a tax credit by passing Ordinances that will (be) based on local public input and specific community conditions,” Rep. John Coghill, one of the bill’s sponsors, said in a statement after proposing the bill.<sup>38</sup>

**Retrofit:** Several devices are on the market to reduce the emissions of these older stoves, and increase efficiency. One style product is a catalytic retrofit and fits in the flue pipe. According to one manufacturer:

“Catalytic retrofits have been tested by several independent testing laboratories over the years. Results showed that some catalytic retrofits decreased burn rate KG/hr by 50.8% and particulate emissions by 49%, while increasing thermal efficiency by 9.2% when used on a pre-phase I, non-catalytic wood burning stove.”<sup>39</sup>

While the claims of these products widely vary, the Borough must evaluate the emissions reduction and whether or not the retrofit will bring the stove into EPA compliance. A homeowner that retrofits their stove would also be eligible for the tax incentive. Retrofits are not readily available and are difficult to install. They increase the difficulty of chimney maintenance that could potentially lead to more chimney fires. Most retrofits are actually installed at the base of the chimney and re-burn exhaust gases directly inside the bottom of the chimney.

**Decommissioning at Time of Sale of Property:** Another successful method to change out stoves is to require decommissioning of non-EPA certified stove when a house is sold. The burden of this requirement falls on the real estate agent or the selling party, but this is one time where documentation and personal inspection are readily available. This process would require that a special woodstove permit be obtained from the Borough and as with the tax incentive program, require that the non-certified stove be turned over to the Borough to be destroyed. Though this method may take years to make a marked change, the results will be steady and secure and more easily enforced.

## **Opportunity 2 - Heavy-Duty Diesel Engines**

### **Emissions from Diesel Engines**

The primary contributor of mobile PM<sub>2.5</sub> emissions in the Borough comes from diesel engines in trucks, buses, and heavy equipment.

### **Descriptions of Various Engine Types and Technical Data**

Diesel engines are primarily classified into two types, light and heavy duty, regardless of whether the engine is mobile or static. How the engine is defined as heavy or light does differ depending on its use. This opportunity for the Borough is focused on heavy-duty road utilized diesel engines, which are identified by the Gross Vehicle Weight Rating (GVWR). Other types of engines are determined by their use. For example, generator engines are based on horsepower. Locomotive engines are based on line-haul or switch duty-cycle.<sup>40</sup>

**Small/light-duty engines:** Small, light duty diesel engines are used primarily in passenger cars and light duty trucks and do tend to get better fuel efficiency than comparable unleaded gasoline engines in the same vehicle model. These engines are not a substantive factor in PM<sub>2.5</sub> emissions in the Borough at this time. Due to fuel price differences between unleaded and diesel gasoline, especially with the movement to low sulfur and ultra low sulfur diesel, these cars and trucks are no longer “cheaper” to run compared to an unleaded gasoline vehicle. It can be assumed that there will not be a large influx of additional light-duty diesel vehicles in the near future to the Fairbanks vicinity.

These vehicles and engines are less than or equal to seven tons GVWR, which includes light trucks and passenger vehicles.<sup>41 42</sup>

**Heavy-duty engines:** Heavy-duty diesel engines are used in semi trucks, buses, marine boat engines, heavy equipment (bulldozers, road construction equipment, earth movement equipment for ore, waste, or fill, locomotive trains, and in some cases larger stand-alone power generators. Depending on how the engine is being used the EPA defines a heavy-duty engine in a vehicle as one consisting of greater than 14,000 pounds GVWR (seven tons).<sup>43 44</sup>

Diesel locomotives owned by the Alaska Railroad were early adopters of ultra low sulfur fuel, well before the recommended EPA deadlines. Since they are already in compliance for ultra-low sulfur fuel conversion and implementation they can be discounted as significant contributors to the PM<sub>2.5</sub> content in Fairbanks. As one of the few methods of mass cargo movement in the

state stopping or restricting usage during days when PM<sub>2.5</sub> counts are high is not realistic or feasible, as some of the outlying communities serviced by the Alaska Railroad are dependent on these deliveries, especially during winter months.

Power generators with heavy-duty engines are usually used on larger buildings that have continuous power needs, such as hospitals, police stations, and data centers. Again, these generators are not a significantly contributor to the PM<sub>2.5</sub> content in Fairbanks as they tend to be used infrequently, usually during either testing cycles (~10-15 minutes once a month for most locations) or when grid power is unavailable (unpredictable and unavoidable).

### **Suggested Diesel Programs**

Diesel exhaust contains many dangerous substances, including NO<sub>x</sub>, SO<sub>x</sub>, aldehydes (primarily formaldehyde, acetaldehyde and acrolein), various hydrocarbons particles and carbon.<sup>45</sup> PM<sub>2.5</sub> from diesel exhaust is worse than other sources of PM<sub>2.5</sub>, including those created by woodstoves and wild fires.<sup>46</sup>

In the Borough, the leading On-Road Mobile source of PM<sub>2.5</sub> is heavy-duty vehicles, including buses.<sup>47</sup> School buses are of particular concern due to children breathing 50% more air per pound than adults.<sup>48</sup>

Fairbanks North Star Borough - Area Sources							
Source Classification Code	2005 Emissions, TPY						
	VOC	NOx	SO <sub>2</sub>	PM <sub>10</sub> _PRI	PM <sub>2.5</sub> _PRI	NH <sub>3</sub>	CO
2103006000 Stationary Source Fuel Combustion Commercial/Institutional Natural Gas Total: Boilers and IC Engines	0	0	0	0	0	0	0
2104004000 Stationary Source Fuel Combustion Residential Distillate Oil Total: All Combustor Types	9	229	605	5	5	0	64
2104005000 Stationary Source Fuel Combustion Residential Residual Oil Total: All Combustor Types	0	2	5	0	0	0	1
2104006010 Stationary Source Fuel Combustion Residential Natural Gas Residential Furnaces	0	7	0	0	0	0	2
2104007000 Stationary Source Fuel Combustion Residential Liquified Petroleum Gas (LPG) Total: All Combustor Types	0	4	0	0	0	0	1
2104008000 Stationary Source Fuel Combustion Residential Wood Total: Woodstoves and Fireplaces	509	19	3	183	183	0	1325
2306010000 Industrial Processes Petroleum Refining: SIC 29 Asphalt Paving/Roofing Materials Total	0	1	1	40	2	0	4
2401001000 Solvent Utilization Surface Coating Architectural Coatings Total: All Solvent Types	241	0	0	0	0	0	0
2461020000 Solvent Utilization Miscellaneous Non-industrial: Commercial Asphalt Application: All Processes Total: All Solvent Types	1	0	0	0	0	0	0
2501000120 Storage and Transport Petroleum and Petroleum Product Storage All Storage Types: Breathing Loss Gasoline	15	0	0	0	0	0	0
2501060102 Storage and Transport Petroleum and Petroleum Product Storage Gasoline Service Stations Stage 2: Displacement Loss/Controlled	150	0	0	0	0	0	0
2501060103 Storage and Transport Petroleum and Petroleum Product Storage Gasoline Service Stations Stage 2: Spillage	8	0	0	0	0	0	0
2501995120 Storage and Transport Petroleum and Petroleum Product Storage All Storage Types: Working Loss Gasoline	8	0	0	0	0	0	0
2810001000 Miscellaneous Area Sources Other Combustion Forest Wildfires Total	3529	1609	441	7292	6254	337	74997
2810030000 Miscellaneous Area Sources Other Combustion Structure Fires Total	3	1	0	3	0	0	39
2810035000 Miscellaneous Area Sources Other Combustion Firefighting Training Total	0	0	0	0	0	0	0
<b>Total Area Source Emissions</b>	<b>4473</b>	<b>1872</b>	<b>1055</b>	<b>7523</b>	<b>6444</b>	<b>337</b>	<b>76433</b>

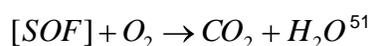
Fairbanks North Star Borough - OnRoad Mobile Sources							
Source Classification Code	2005 Emissions, TPY						
	VOC	NOx	SO <sub>2</sub>	PM <sub>10</sub> _PRI	PM <sub>2.5</sub> _PRI	NH <sub>3</sub>	CO
2201001000 Mobile Sources Highway Vehicles - Gasoline Light Duty Gasoline Vehicles (LDGV) Total: All Road Types	308	173	7	5	2	18	4101
2201020000 Mobile Sources Highway Vehicles - Gasoline Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5) Total: All Road Types	396	236	9	6	3	19	5658
2201040000 Mobile Sources Highway Vehicles - Gasoline Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5) Total: All Road Types	304	194	8	4	2	13	3711
2201070000 Mobile Sources Highway Vehicles - Gasoline Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV) Total: All Road Types	91	240	5	5	4	2	717
2201080000 Mobile Sources Highway Vehicles - Gasoline Motorcycles (MC) Total: All Road Types	7	5	0	0	0	0	39
2230001000 Mobile Sources Highway Vehicles - Diesel Light Duty Diesel Vehicles (LDDV) Total: All Road Types	0	1	0	0	0	0	1
2230060000 Mobile Sources Highway Vehicles - Diesel Light Duty Diesel Trucks 1 thru 4 (M6) (LDDT) Total: All Road Types	2	3	1	0	0	0	3
2230070000 Mobile Sources Highway Vehicles - Diesel All HDDV including Buses (use subdivisions -071 thru -075 if possible) Total: All Road Types	52	1366	131	51	45	3	280
<b>Total On-Road Emissions</b>	<b>1160</b>	<b>2218</b>	<b>161</b>	<b>71</b>	<b>56</b>	<b>55</b>	<b>14510</b>

Four possibilities exist to address the amount of PM<sub>2.5</sub> produced by heavy-duty diesel engines:

- Retrofit with diesel oxidation catalysts (DOC)
- Retrofit with diesel particulate filters (DPF)
- Ultra low sulfur diesel fuel (ULSD)
- Idling regulation

### Diesel Oxidation Catalysts

DOCs use a substance that speeds up a chemical reaction, in this case oxidizing soluble organic fraction into carbon dioxide and water.<sup>50</sup>



Depending on fuel and engine type, a DOC can remove 20% to 40% of total PM and while they do not remove PM from elemental carbon it does from organic carbon. Additionally, DOCs reduce hydrocarbon and CO pollution from exhaust.<sup>52</sup> Potential side effects from DOCs can be the production of ultrafine particulates when paired with non-ULSD fuel. However, many DOCs have been formulated to assist in reducing ultrafine particulates when used with non-ULSD fuel.<sup>53</sup> Depending on the catalyst used, some DOCs may increase the NO<sub>2</sub> created, but DOCs verified by the California Air Resources Board (CARB) and EPA comply with NO<sub>2</sub> and NO<sub>x</sub> limits. The EPA and CARB have an agreement to accept DOCs on either approved list.<sup>54</sup>

Depending on engine type and age, DOCs can cost anywhere from \$600 to \$2,000 for parts and installation.<sup>55</sup> The main maintenance costs associated with them is high temperature oxidation of sulfur. ULSD reduces the amount of sulfur in the fuel, also reducing the sulfur build up and maintenance cost to burn it off. This sulfur will need to be removed every other year to four times a year via thermal cleaning at about \$178 a year.<sup>56</sup> Anchorage School District has retrofitted 74 buses with DOCs successfully.<sup>57</sup>

Per ton of PM removed from school buses and Class 8b trucks has an average cost of \$11,000 to \$50,000 using DOCs.<sup>58</sup>

### Diesel Particulate Filters

DPFs are filters that can replace the muffler of a vehicle. When used in conjunction with ULSD DPFs can result in as much as 90% reduction in total PM.<sup>59</sup> Build up is cleaned from the filter by using high heat to oxidize the particulate build up. Catalyzed diesel particulate filters (CDPF)

have a coating of a catalyst to reduce the temperature needed to clean the filter.<sup>60</sup> Using a biodiesel mix may also assist in lowering the necessary temperature.<sup>61</sup> Passive DPFs, those without assistive electric heaters may not be as efficient at removing particulates or require more frequent replacement and cleaning during the winter in Alaska.<sup>62</sup> DPFs also remove hydrocarbon and CO from exhaust.

DPFs are priced from \$5,000 to \$10,000, not including electric heaters.<sup>63</sup> Maintenance needed is periodic cleaning of the filter and replacement. Filter cleaning is usually every one to two years or 60,000 to 100,000 miles. Most filters are cleaned on the vehicle using heat, but some need to be removed and cleaned by a company, while others are cleaned using pressurized air or water.<sup>64</sup> The filtered material is considered hazardous waste by the state of California.<sup>65</sup>

Per ton of PM removed from school buses and Class 8b trucks costs in the range of \$12,100 to \$69,900 using CDPFs.<sup>66</sup>

Calendar Year 2007 Estimated Retrofit Costs for Combined Class 6&7 and School Buses, and for Class 8b

<b>Cost Component</b>	<b>Diesel Oxidation</b>	<b>Catalyzed Diesel Particulate Filter (CDPF)</b>
Substrate/Coating/Canning	\$260	\$1,920
Additional exhaust tubing and mounting hardware	\$87	\$300
Datalogging and testing for CDPF regeneration	-	\$100
Installation	\$193	\$193
Class 6-7 and School Buses Total (2 significant figures)	\$540	\$2,500
Ratio Class 6&7 to Class 8b	13/8 times	13/8 times
Class 8b Retrofit Cost (2 significant figures)	\$880	\$4,100
Class 8b Maintenance Cost	-	\$208
Total Class 8b Cost (2 significant figures)	-	\$4,300

Ultra Low Sulfur Diesel

ULSD will be mandatory in Alaska starting June 1, 2010.<sup>68 69</sup> According the EPA, under normal circumstances there should be no difference seen between low sulfur diesel and ULSD. However, they also note that there may be a small change in miles per gallon as some energy is removed at the same time the sulfur is removed.<sup>70</sup> ULSD must be used with diesel vehicles 2007 and later, because other fuels will cause damage to the engine.<sup>71</sup> ULSD paired with either

a DOC or either type of DPF reduces much more particulate than without and also lowers maintenance costs of both. In vehicles older than 2006, ULSD may cause the fuel filter to plug up due to loosened deposits from the fuel system at the start of use. The EPA suggests using oil formulated to be used in engines using ULSD fuel. Additional lubricants and corrosion inhibitors may also need to be added to the fuel when used with older vehicles,<sup>72</sup> though as one Alaskan town found out, not all lubricants can be used for all systems. Lubricant added to ultra low sulfur heating oil plugged up fuel filters and ruined fuel pumps in heating systems.<sup>73</sup> ULSD does have problems with very cold temperatures, like those that Fairbanks experiences in January and February. Ultra low sulfur kerosene and other specialized additives can be added to ULSD to lower the temperature of the fuel gelling.<sup>74</sup>

A 2001 study by the Energy Information Administration estimated that ULSD would cost an additional 5 cents per gallon to manufacture, which does not cover the addition expense to transport the fuel (higher fuel prices).<sup>75</sup> Additional maintenance costs of fuel filters; ULSD formulated engine treatments and non-gelling additives will vary depending on the year and type of vehicle.

A press release from the EPA estimated that once ULSD was fully used it would reduce the amount of total PM by 110,000 tons and would cost about \$4 billion per year for those reductions. It did not break down those costs. This would put the price per ton removed annually at approximately \$36,364.<sup>76</sup>

### Anti-idling Regulation and Devices

Reducing idling of heavy-duty vehicles, school buses and gasoline vehicles would also reduce PM pollution. Pennsylvania estimates that their anti-idling regulation, when enacted, will remove almost 30 tons of total PM.<sup>77</sup> While this paper only addresses heavy-duty vehicles, applying this to passenger cars would also significantly reduce PM. People are more likely idle vehicles when it is extremely cold and when air quality seems to be at its worst. However, it is already in the Alaskan Administrative Code to not allow unattended motor vehicles to idle and it is a \$50 fine.<sup>78</sup> Truck drivers idle to keep the engine warm, provide heat, cooling and electricity to their cabin while parked for their mandatory rest periods.

Installations of anti-idling devices vary. A cabin heater costs about \$1,500, and an auxiliary power unit or generator is about \$6,000 - \$8,500.<sup>79</sup> Another option is electrified rest areas for truckers. There are two types of parking areas, one requires both site and truck modifications

and may cost anywhere from \$200 to \$3,000 for the truck set-up plus a fee paid by the user for electric used. The actual parking spaces themselves would also need to be set-up to provide power and range in cost from free (with a money sharing program) to \$2,500 a space.<sup>80 81</sup>

The second type of electrified parking spaces requires little if any modification to the truck and instead relies on the equipment of the space itself. The IdleAire brand electrified spot, for instance, requires a \$10 window adapter to be installed and the utility hose hooks in to that. Piped in through this hose along with heat, are internet access, cable TV, and electricity. Basic service includes filtered heat and A/C, 120V electric outlets, built-in touch screen control with Internet access, phone access for incoming & outgoing calls, and television. Users pay \$2.45 to \$2.89 an hour for the service. At this time, setting up parking spaces for this service is free, and they pay out a percentage of what they make to the lot owner.<sup>82</sup> However, this technology has not been tested in Alaska. It is an intriguing idea, but a pilot program needs to be done.

On average, a truck uses a gallon of diesel for every hour of idling. Using this technology for the approximate 1,200 hours of idle time, adds up to \$3,828 in saved fuel costs in one year, quickly paying off even the more expensive generator or auxiliary power supply.<sup>83</sup>

The best possibility for meeting PM<sub>2.5</sub> requirements is to implement mandatory PM devices on heavy-duty vehicles and buses. If at all possible they should use catalyzed diesel particulate filters, though for some vehicles a DOCs may be the choice. Additionally, semi-trucks should be outfitted with APS or efficient generators and should not idle in the non-attainment area. Powered parking spaces should be investigated.

It is more difficult to pass a law related to pollution in the summer while the air is better, but the process should be started to mandate DPFs and only for those vehicles, including buses (both passenger and school) that cannot be retrofitted with DPFs should catalytic DOCs be used. Enforcement may be done at weigh-in.

Idling of diesel engines needs to be significantly reduced in the non-attainment area. A better public marketing system needs to be developed to educate the general public on idling laws and why they should not be idling their cars more than five minutes (new cars, and how bad it is on the engine and fuel efficiency.) Additionally, a law should be passed to not allow semi-trucks to idle in the identified non-attainment area. Adding an auxiliary power unit (APU) allows the engine heater to keep the engine un-frozen and to heat up the cabin. However, enforcing this will be more difficult than the exhaust units. Expensive units or global position systems can be

installed to monitor idling time. However, this is costly to enforce, install and maintain. It might be better to invest the money into the environmental conservation officers and have them extend their duties in the severe cold. However, in some ways anti-idling laws are self enforced once fleets start to realize money savings from less fuel being used.

ULSD complements both of the items discussed above. Pairing a CDPF and ULSD fuel is estimated to reduce PM by 90% of the vehicles original PM output.<sup>84</sup> The EPA is already addressing this, though it would help to meet attainment if the Fairbanks area could move to it sooner, though supply may not be available. Already local gas stations, such as Fred Meyer, are only selling ULSD.

<b>Table 3 Measured Emissions and Emission Reductions, 1999, Buses with Diesel Oxidation Catalysts (DOC) and 300 ppm Sulphur Diesel Fuel Relative to Diesel Particulate Filters (DPF) and 30 ppm Sulphur Diesel Fuel<sup>a</sup></b>									
	HC (g/km)	CO (g/km)	NO <sub>x</sub> (g/km)	PM (g/km)	Carbonyl <sup>b</sup> (mg/km)	PAHs <sup>c</sup> (µg/km)	NO <sub>2</sub> -PAH (µg/km)	SO <sub>4</sub> (mg/km)	SO <sub>2</sub> (mg/km)
DOC & 300 ppm sulphur	0.135	1.23	14.9	0.122	46.6	39.8	2.73	38.5	182
DPF & 30 ppm sulphur	0.009	0.075	15.5	0.015	0.31	9.01	0.621	8.08	4.47
Emission reduction	-93%	-94%	+4%	-88%	-99%	-77%	-77%	-79%	-98%

85

Federal monies are available for assisting programs reduce diesel emissions, particularly for those areas that are in nonattainment. EPA monies are primarily dispersed through two programs, the American Recovery and Reinvestment Act of 2009 (Recovery Act) and the EPA's Fiscal Year 2009 Appropriations. The Recovery Act will be \$300 million in funding and the EPA's 2009 Fiscal Appropriations will be \$60 million.<sup>86</sup> These two programs will joint fund many of the available programs such as the National Diesel Campaign. Some grant programs require the state to match funds to receive additional monies, such as the State Clean Diesel Grant Program.<sup>87</sup> Grants to provide low cost loans are also available through the SmartWay Clean Diesel Program.<sup>88</sup> Most of these programs fund diesel retrofits with EPA or CARB certified or verified products, EPA-verified idle reduction equipment, and incremental costs associated with early replacement of some engines.<sup>89</sup> Some idling reducing equipment, such as fuel-operated heaters, APUs and shore connection systems, are excluded from the federal excise tax if they are from the federal list.<sup>90</sup>

<b>Funding Program</b>	<b>Amount in Millions</b>
The Recovery Act Funding for the National Clean Diesel Funding Assistance Program	\$156
The Recovery Act Funding for the National Clean Diesel Emerging Technology Program	\$20
The Recovery Act Funding for the SmartWay Clean Diesel Finance Program	\$30
The Recovery Act Funding for the State Clean Diesel Grant Program	\$88

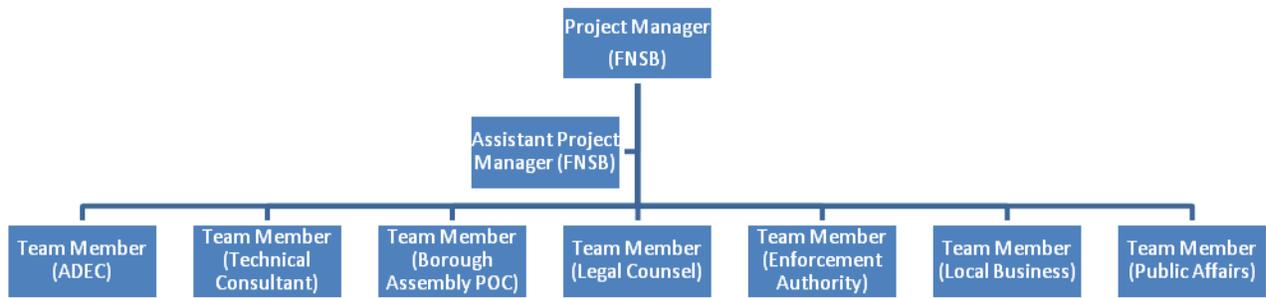
91

This year is particularly good year for grants and other funding. The state and Borough should not delay, as the applications for most Recovery Act funded monies are due by April 28<sup>th</sup>.<sup>92</sup>

### **Project Management Approach**

#### **Teams**

Projects are most often comprised of teams, because in today's world the solutions for many problems are too complex for a person or a small group of people to solve.<sup>93</sup> Reaching an attainment status in the Borough for PM<sub>2.5</sub> is a complex problem and will require a team approach to solve it. Key stakeholders should be assigned to be a part of the team for this project. Although the EPA has created the law and set the standard, the State of Alaska and the Borough have a large part to play in reaching attainment status. Local personnel at a project site are often much more in tune with the problem and the ways to solve it than people or agencies who are physically remote from the project site. It's the recommendation of this report that the Borough formulates a team, similar to the one shown below, for management of the project. The project manager would be required to have regularly scheduled meetings and determine which team members should be present. Full team meetings should be held at least semi-annually and possibly more frequently during critical periods of activity from the schedule. The project manager should have direct access to the FNSB mayor and be required to provide quarterly reports on the project status during FSNB staff or assembly meetings. The FNSB needs to ensure that the project manager be given sufficient time to meet the requirements of this duty.



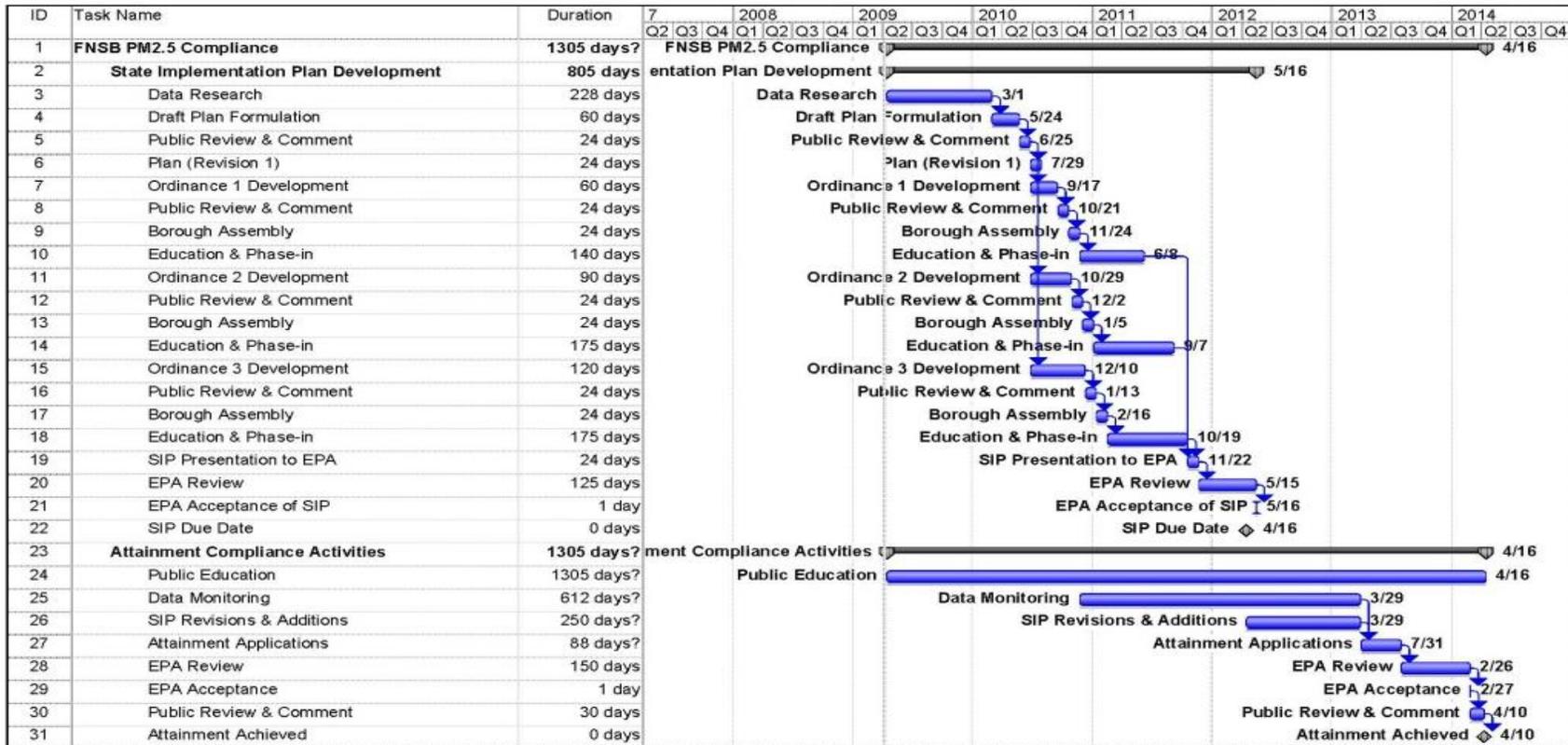
## Schedule

A critical part of project management is ensuring that the task at hand is completed within the allowable timeframe or schedule. There are negative social, legal, and financial consequences associated with not meeting EPA's required attainment date as have been discussed in previous sections. For the Borough, complying with the EPA's schedule may outweigh costs associated with coming into compliance in some cases. There are a multitude of factors that come into play on the FNSB's ability to complete this project on schedule making it a very complex one to manage. A number of elements for compliance will be well outside the project manager's ability to control and will require a project manager who has thick skin, the ability to see the big picture, and who can maintain positive over a long drawn out project life cycle. For example, achieving attainment will require an unspecified number of ordinances to be adopted by the Borough. The Borough has the authority to enact area-wide air pollution control regulations according to AS§46.03. Ordinances require a public hearing and majority vote of the Borough Assembly. An ordinance goes into the next business day after adoption and then will require continued data monitoring afterwards to determine if the ordinance is having the desired effect. Passing of a new Borough ordinance can be influenced by the project manager but is well outside of his ability to control. Occasionally residents oppose ordinances that may improve the general welfare of the community because the costs are too high or the residents don't want to give the government more control.

Despite the issues with achieving attainment, the Borough needs a schedule that is managed by a project manager. Without a schedule and project management, the likelihood that the Borough will meet the EPA's attainment timeline diminishes significantly. While rough in magnitude, a potential schedule for meeting the EPA's required attainment timeline is shown below.

Schedule development for this project is beyond any one person's ability and would need to be completed jointly between the Borough staff, assembly, and the ADEC. The combination of experience amongst these interested parties would make it possible to complete an achievable schedule. With a managed schedule, there is a chance of meeting the EPA's attainment dates. Without a schedule it is doubtful that the Borough will happen upon attainment within the EPA's timeline. The schedule, once developed, should be updated quarterly to add additional activities and revise actual completion dates. Even if the schedule slips, at least the Borough will know what the subsequent impacts on the overall completion are and can begin to manage the impact and fallout from schedule changes. It is far better to notify the EPA six months to one year ahead of time that deadlines will not be met, then to explain that a few months after the deadline has passed.

Being responsible for the project schedule is one major element of project management and so is the case in the Borough's effort to reach  $PM_{2.5}$  attainment status. The schedule should be built through a team approach, approved by the Borough Mayor and ADEC, Air Quality Division and updated quarterly by the parties involved



Project: Schedule Date: Mon 4/6/09	Task		Milestone		External Tasks	
	Split		Summary		External Milestone	
	Progress		Project Summary		Deadline	

Page 1

## Recommendation/Conclusion

The Borough has important and long lasting decisions to make concerning how to best reduce PM<sub>2.5</sub> emissions. The two opportunities being focused on are good starting points for the Borough; however, more examination will be needed to determine which alternatives will result in the most reduction for the least cost, and, more importantly, which opportunities are most likely to succeed.

Recommendations for wood stoves: A wood stove change-out program tied to tax incentives is the most obvious and straightforward program to implement. Residents that upgrade to an EPA certified wood stove would actually be investing in an appliance that is more efficient and saves them fuel (aka money) over the lifespan of the appliance. In addition they will get a tax credit and have the satisfaction of helping clean the environment. Having an EPA certified wood stove will also ensure that their exposure to burn-ban days is significantly lowered when compared with non-EPA certified wood stove operators. In the FNSB this alternative is already being researched and will likely be a top candidate for inclusion in the SIP. Also recommended would be a change-out at time of sale program. This is an ideal time to ensure that homes are equipped with the right type of appliance. It is common during this transaction for septic systems to be re-built and other home repairs to be accomplished. The stove upgrade can be accomplished at this time without significant cost and will likely result in full compensation to the home seller. It benefits the homebuyer who occupies the home with a newly refurbished home heating system that will be trouble free for years to come. Retrofitting a non-compliant stove to bring it into EPA compliant limits should be considered an equally acceptable alternative.

Lastly, it is highly recommended to use media campaigns that encourage voluntary burn bans during measured or forecasted times of high PM<sub>2.5</sub> concentration. Implementing a mandatory burn ban program will be a challenge in Interior Alaska since so many homes depend on wood heat, especially as the temperatures dip below -40°F. However, the community pulled together to become a CO attainment area and it can do so again for PM<sub>2.5</sub> attainment. The voluntary burn-ban should be focused on those areas within the non-attainment area that contain the densest population. Public education can identify and communicate which areas are involved in the burn-ban. Perhaps the Borough can offer incentives for residents who attend a seminar on particle pollution and sign an agreement to voluntarily participate in burn-ban days.

Wood stove recommendations summary:

- Establish a tax incentivized wood stove change-out program
- Establish a time of sale wood stove change-out program
- Develop a supportable burn-ban program that is heavily tied to public education

Recommendations for large diesel vehicles: Regulation should be enacted that mandates that those vehicles that can be retrofitted with a DPF, should be and the remaining vehicles unable to, be retrofitted with DOCs. An anti-idling law should be enacted and enforced for the minimization of idling in the non-attainment area. Additionally, ULSD should be the only diesel sold in the non-attainment region as soon as possible. Electrified truck rest areas need to be investigated to discover if they can handle Fairbanks' winters. A public media campaign also needs to be used to educate the public on idling personal cars during days found to have poor air quality.

Heavy-duty diesel recommendations summary:

- Enact retrofit regulation (DOC only if unable to retrofit a DPF)
- Enact anti-idling regulation
- Mandate early acceptance of ULSD

The Borough's effort to reach attainment should be treated as a project. It has a clear goal and a clear timeline. It has an associated cost but because this is a public entity effort, the cost is less of a factor than in other settings. The Borough struggled to meet the EPA's compliance timeline for CO standard attainment and one of the benefits to Project Management is a dedicated focus on performance within the schedule. The following actions are recommended to establish and track this effort as a project:

Project Management Recommendations Summary:

- Identify a Project Manager, Assistant Project Manager, and Team
- Identify clear project goals and resources such as:
  - Complete the SIP by April 2012
  - Phase in new policies by November 2011
  - Gather 24 months worth of data prior to attainment application time (November 2013)

- Apply for either attainment or an extension no later than April 2014
- Establish recurring reporting procedures for the team to update the Borough Mayor and Staff on progress
- At the conclusion of the project, disband the team and put the particulate pollution program into maintenance status where it is handled by a program manager

## **Conclusion**

EPA policy does not allow them to consider the costs associated with tightening the NAAQS as part of their evaluation of new standards. At a local level where the “rubber meets the road”, the costs resulting from tightened particulate matter standards are real and will be felt by thousand of if not tens of thousands of Borough residents. Many residents may not feel that particulate pollution is a problem at all or that it’s a Fairbanks problem, not their own problem. This may be especially true when it comes time to spend \$2,500 or more changing out a wood stove. Nevertheless, the fact remains that the core area of the FNSB is legally a non-attainment area and that status has potential effects of a magnitude that is beyond the collective effect on individual residents within our community. The proof is in the data and it really can’t be argued. Reliable studies have shown that exposure to particulate matter correlates with numerous health conditions and even pre-mature death. Data collected in the Borough shows that the EPA standard for PM exposure on the 24-hour measurement period is exceeded, sometimes by as much as 200%. This means that there are residents of our community whose health is being negatively affected and who lives are being shortened by this problem and that means something needs to be done to address it. Will meeting the EPA’s standards mean that all negative health concerns go away? Certainly not But it does mean that the Borough has accomplished something that has tangible effects on the community and the health and welfare of the Borough’s residents. The Borough is too great a place to not do everything possible to ensure it, including its happy and healthy residents, will be around for generations to come.

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## **Acronyms and Abbreviations**

ADEC:	Alaska Department of Conservation
AK DOT:	Alaska Department of Transportation
APU:	Auxillary Power Unit
BC:	Benefit Cost (AKA Cost Benefit)
CAA:	The Clean Air Act of 1970
CARB:	California Air Regulation Board
CASAC:	Clean Air Scientific Advisory Committee
CCHRC:	Cold Climate Housing Research Center
CDPF:	Catalytic Diesel Particulate Filter
CE:	Cost Evaluation
CO:	Carbon Monoxide
DOC:	Diesel Oxidation Catalyst
DOT:	Department of Transportation
DPF:	Diesel Particulate Filter
EPA:	U.S. Environmental Protection Agency
FIP:	Federal Implementation Plan
FNSB:	Fairbanks North Star Borough (the Borough)
GVWR:	Gross Vehicle Weight Rating
I/M:	Inspection and Maintenance
MACS:	Metropolitan Area Commuter Service
NAAQS:	National Ambient Air Quality Standards
NEPA:	National Environmental Policy Act
NESHAPS:	National Emission Standards for Hazardous Air Pollutants
NO <sub>x</sub> :	Nitrogen Oxides (including dioxide, monoxide, etc)
NSPS:	New Source Performance Standards
PM:	Particulate Matter
PM <sub>10</sub> :	Particulate Matter, Course
PM <sub>2.5</sub> :	Particulate Matter, Fine
SIP:	State Implementation Plan
So <sub>x</sub> :	Sulfur Oxides (including dioxide, monoxide, etc)
TPY:	Tons per Year
ULSD:	Ultra Low Sulfur Diesel
µg/m <sup>3</sup> :	Micron per Cubic Meter

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